CITY IN TRANSITION :
Aspects of Industrial and Urban Development in Koahsiung,Taiwan

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ABSTRACT

Koahsiung, the largest industrial harbor city in Taiwan, is in a stage of transition, characterized by the presence of urban evolution after the economic upswing brought about by industry in the last few decades. The confused relationship between the people and their environment provides evidence of this transition. Two issues concerning the urban environment of Koahsiung at present are: first, the centeral urban areas faces growth pressures because of the strengthening of the city function; and second, industries in the urban area create spatial dilemmas in efforts to address questions of urban growth. Undesirable form of mixed land use and degradation of the environment are obvious problems. Understanding their origin and exploring opportunities for solving them will mean investigating closely the relationship between the industry and urban development. Restructuring the role of industry in the urban area and improving the use of urban land are challenges in facing the conflict of urban industry and human environment.

This thesis also attempts to address the burning issues of informal sector accommodation in mixed use areas.

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Title: Visiting Lecturer, School of Architecture and Planning

In front of my house is a river,
And in the back a slope.
The slope is flower-covered,
Red as if on fire.

In the river are white geese.
The geese play with the waves.
Playing in the water the geese are happy.
They lift their heads and sing a song.

- Chinese Children's Rhyme

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(All the photos and drawings are done by the author, except those otherwise specified.)

INTRODUCTION

Political changes transformed Taiwan's economy from a colonial to an autonomous system after the recovery from Japanese rule in 1945.[1] The low-wage labor production system and the international commercial boom led to an economic upswing in Koahsiung before 1970. After 1970, world-wide economic growth began to slow down, while in Taiwan the pressure for growth in urban wages increased. At the same time, it became difficult to employ and accommdate the young laborers from the countryside. Taiwan's production system began to be restructured from labor-intensive to technology-based,[2] which influenced the spatial redistribution of production in the main cities. The production system began to include informal systems in addition to the already existing formal systems in order to increase its ability to compete. Medium- and small-scale industries became an important part of the system and significantly influenced the spatial structure of the city.

Immigrants from other cities in southern Taiwan settled the urban fringe of the area during the period of Japanese rule and transformed it into a metropolitan area in the period after the Second World War.[3] In

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[1]The function of the city in Taiwan set by the Japanese is according to the economic demand or political strategy to the world. See Huang, She-Mang The Paradigm of City Planning in Taiwan in the Japanese Rule Period ,1987, Graduate School of Civil Engineering Department of Taiwan National University. p.65.

[2] See Sun, Yi-Chong "Regional Planning Policy of Taiwan," Taiwan: A Radical Quarterly in Social Study, Vol1: 2,3. 1988, p.62.

[3] See Table 1: Metropolitan population distribution and growth. Chang, Chung-Ming, "Study of Residential Spatial Structure in Koahsiung Metropolitan Area," Graduate School of Urban Planning in Jung-Shing Univ. Thesis, 1987.

the regional planning of southern Taiwan in 1974, the national government developed industrial zones in towns of the metropolitan area in an attempt to rationally distribute the population, places of production, and resources of Koahsiung city (Fig.1).[1] Although the urban population is spread across the rest of the metropolitan areas for work or residency, the typical urban consumption patterns of Taiwan are such that the city has retained its function as a center of consumption and services for the metropolitan area.[2] In addition, through the restructuring of the production system of the city, the business services and commercial activities are gradually becoming dominant.[3] These transformations will disrupt the population structure and change how people see their environment, as well as what they expect from it. All these factors have acted on the physical urban environment of today. The seeming chaos in the urban areas of Koahsiung reflects the interaction of the logic of capital and the urban spatial structure.

A large amount of medium- and small-scale industries were introduced into the city in the last two decades. These smaller industries, together with the original large-scale industries which had been at the urban perimeter, formed "industrial frontiers," now imbedded deep inside the growing metropolis. The conflict between the

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[1]See Sun, Yi-Chong, "Regional Planning Policy of Taiwan," Taiwan: A Radical Quarterly in Social Study, Vol1: 2,3, 1988.

[2] See Report for Kohsiung Auo-Zuedi Sub-city Center Development, Graduate School of Civil Engineering Department of Taiwan National University, Introduction1-1.

[3] See table 2: Population of the productivities from 1971 to 1981, Investigation of Industry and business in Koahsiung, 1981.

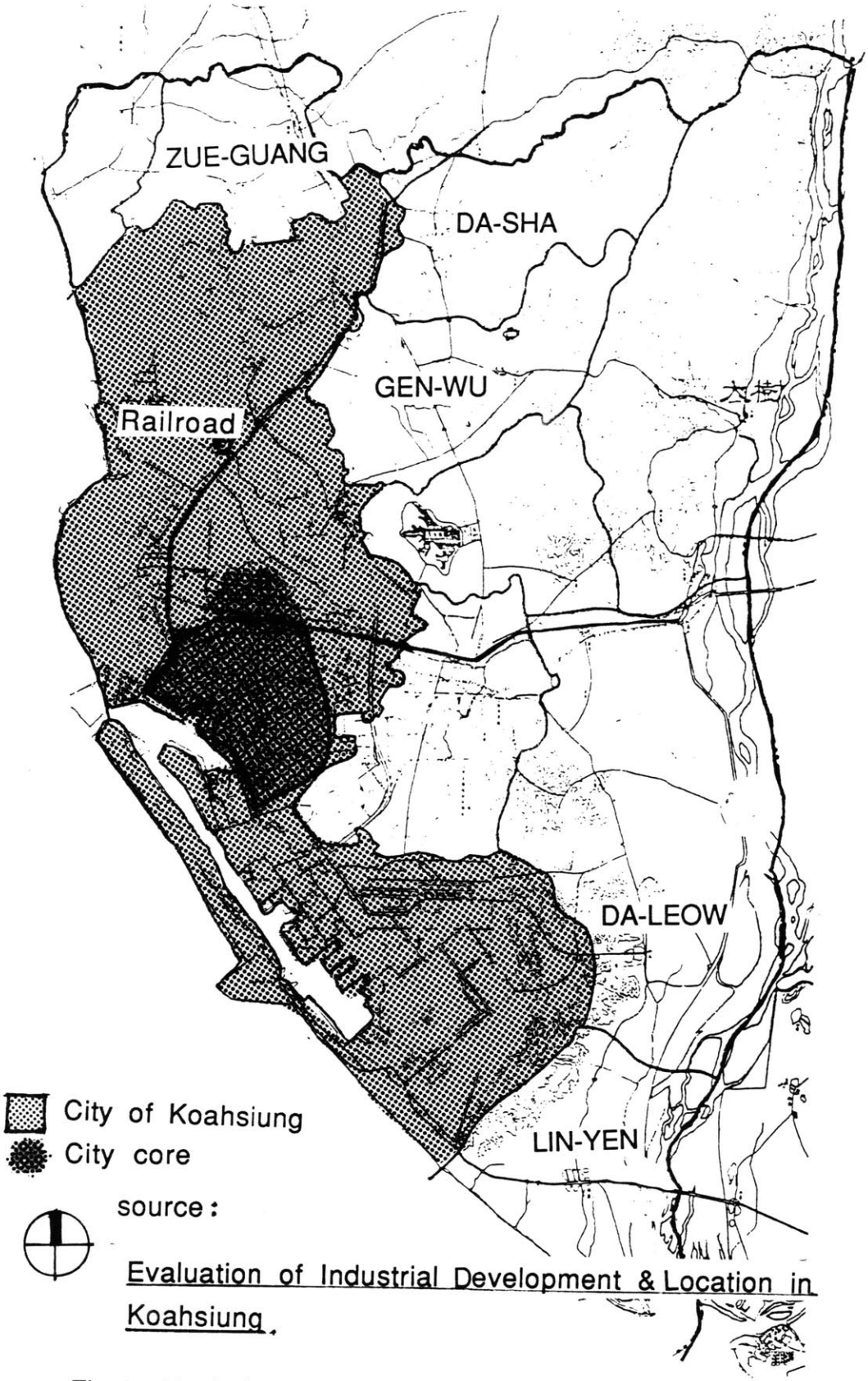

Fig.1 Koahsiung Metropolitan Area & the City Core

"frontiers" and "normal" urban development actually reflects the conflict between different social statuses.[1] A well-managed physical environment must be based on a social and economic vision of a balanced, more harmonious city.

Since the industrial belt, the "inner frontier," is home to the elements of Koahsiung's society, a careful securing and redistribution of spatial resources must anticipate Koahsiung's economic and social evolution. The urban spatial structure has to be reformed and must reach a state of balance between the frontier formed by production systems and the residential areas.

This thesis provides at its outset an overview of the historical and spatial relationship between industrial growth and urban planning since the period of Japanese rule. After that, I will look at the industrial frontier in the urban area today and focus on the issues of industry, because its occupation of the central urban area has led to a face-to-face, partially symbiotic conflict with the people's living environment, and has, in some sense, shifted the growth of the central urban area. Finally, I will choose the next potential site for urban development and identity the issues worth studying by listing and analyzing the problems. I will then suggest an approach to solving the problems while satisfying the sophisticated interrelationships in the urban

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[1] " ...The chaos in the urban context shows evidence that it is the spatial structure controlled by the market (or logic of capital). This is because urban space is determined by the social productivities, which are the result of different social statue conflict...." Quote from interview with Manuel Castells, Taiwan: A Radical Quarterly in Social Study, 1988, Preface.

evolution of industry and human living environments. At the end of the thesis, an image for the future of the potential site is proposed in a collage description, following an analysis of the problems.

Spatial arrangement is also important in this thesis, since the disorder in the relationships between single units and the urban scale is the main concern and the basis for the proposed solutions. The original idea behind the analysis of the spatial relationships is from John Habraken in his Transformation of the Site, which tries to explain the urban phenomenon through analyzing the interaction of forces involved in the formation of space and form. However, we do not exactly follow the steps of his process of analysis, because the interactions within the two urban contexts are different in their economic and cultural backgrounds.

CHAPTER I

URBAN DEVELOPMENT BACKGROUND

1.1 GENERAL DESCRIPTION

Koahsiung originated as a small village on the Chi-Ging island, which was located outside Koahsiung Harbor. The city experienced different political changes during the Dutch rule, the Ming Dynasty, the Ching Dynasty and the period of Japanese rule. When we look at the map of the city, we can see an obvious city core defined by the railway--the central urban area of Koahsiung today (Fig.1). The city planning after the recovery of Koahsiung at the end of World War II is based on the planning in the period of Japanese rule. Most of the industrial locations of the city today are the same as those used in the period of Japanese rule .

The industrial development in Koahsiung started in 1900 with the pineapple industry, which was the first basic production industry run by the Japanese in the city. The products of industry in the city were agricultural at the early stage, followed by iron production and non-metal mining production. After the start of the Second World War, the Japanese began to build heavy industries in the southern area of the city core. In the period after recovery from Japanese rule and before 1970, large-scale industrial development, which was mostly heavy

chemical production,[1] turned industry into a vital economic support for the southern area of Taiwan. After 1970, global recession lead to the change of Taiwan's economic production structure. Medium- and small-scale industries began to decentralize the centers of production. The location of the industries in the city after the period of Japanese rule was also greatly affected by the subsequent economic changes.

There are two facts which affect the industrial development of Koahsiung: one is the construction of the harbor, and the other is the construction of the railway. In the period of Japanese rule, the harbor was used mainly to export the products of southern Taiwan to mainland China, Japan, and other countries in Asia, while the railroad was used to transport the products to the inner cities. Another result of the harbor's construction was expanded urban development. The plans for the harbor were produced simultaneously with the planning of the urban area. The location of the industries either followed the expansion of the city edge, which was directly affected by the changes of the harbor construction, or followed the locations of railway stations. The forming of the growth pattern of Taiwan's city is strongly related to the location of railway stations. The area in front of a station was used as a commercial area and the back side of the station was developed into an industrial area.[2] After the recovery, the government started to make strategic industrial developments in some specific areas, such as

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[1] See Cheng, Geing-Hwa, Simulation of the Koahsiung industrial development system-- Use DRAM model for Example, Chung Shing Univ. Graduate school of urban planning thesis, 1986, p.75.

[2] Wu, Ching-Sheing, Research of City Planning and Growth of Taiwan in the Period of Japanese Rule, 1988.

the Nan-Zue export processing industrial area and the Show-Gong industrial area (see Chapter 2.1.1 p.24). The harbor increased the potential and ability of Koahsiung's industrial development to go forward and to become an international harbor city.

1.2 FIVE URBAN STAGES

According to the categorization by Ching Sheng Wu in Research of City Planning and Growth of Taiwan in the Period of Japanese Rule, the city planning of Koahsiung in the period of Japanese rule can be divided into four stages:

The First Stage - from June, 1895 to April, 1908, which dates from the beginning of the Japanese occupancy to the announcement of the first revised urban plan of Ta-Gow (the original name of Koahsiung) (Fig.2a).

The Second Stage - from May, 1908 to February, 1921, which designates the period from the announcement of the first revised urban plan to the announcement of the first urban expansion plan (Fig.2b).

The Third Stage - from February, 1921 to October, 1932, which marks the time from the announcement and execution of the first urban expansion plan to the announcement of the Metro-Kouahsiung urban plan (Fig.2c).

The Fourth Stage - from October, 1932 to August, 1945, which delineates the period from the announcement of the first Metro-Koahsiung urban plan to the end of the period of Japanese rule (end of the Second World War). (Fig.2d)

After recovery - From August,1945, which dates from the end of the period of Japanese rule till November, 1945 - the first reannouncement of the Koahsiung urban plan by the new government.(Fig.2e)

The reason for applying this categorization is that there are clear distinctions between the four stages, in which each urban plan has greatly affected the expansion of the city. Thus we can observe the sequence of the urban evolution from the changing of the location of the urban and industrial areas of Koahsiung.

THE FIRST STAGE
(1895.6 - 1908.4)

Main industry:

Sugar, pineapple

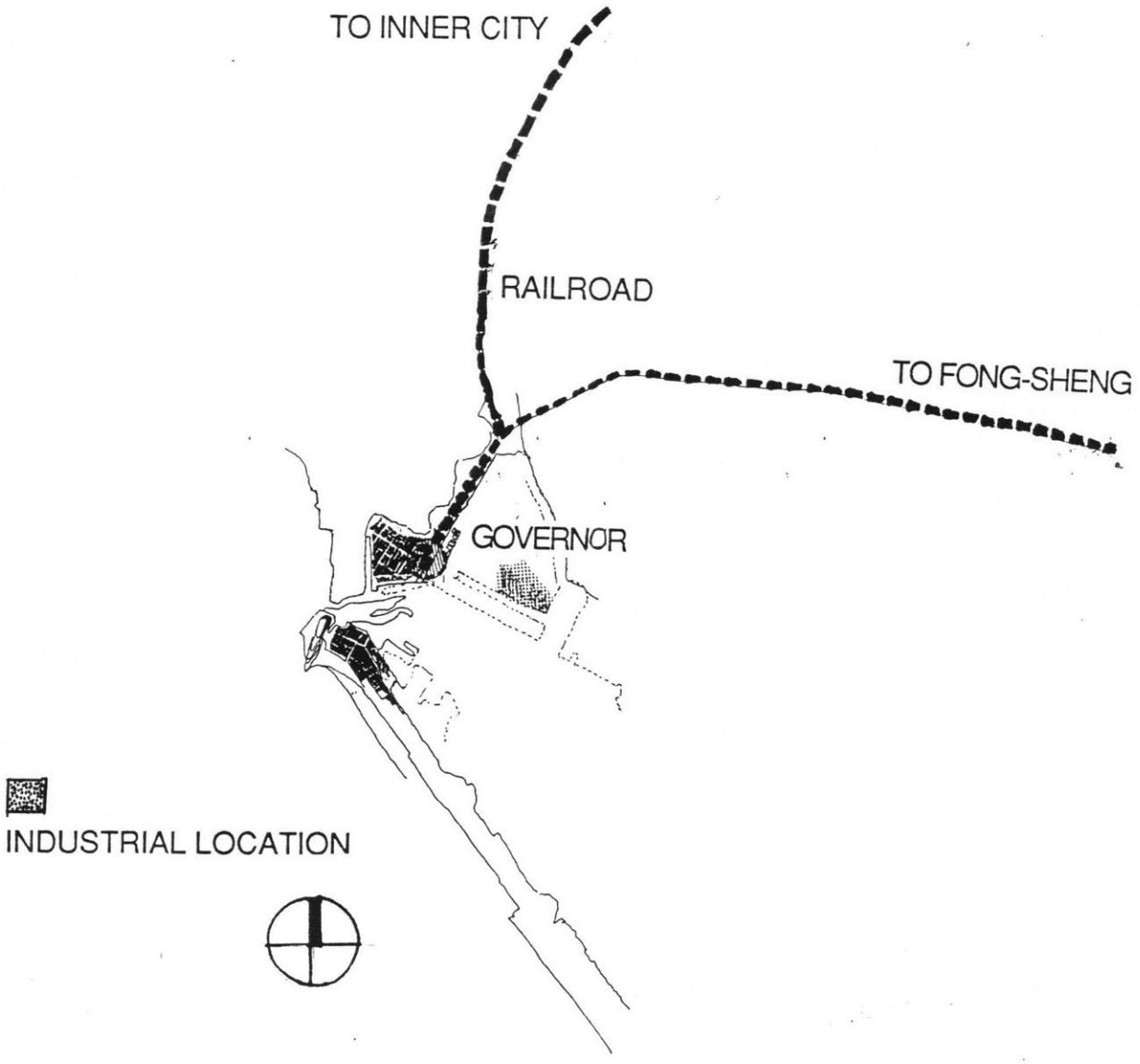

Fig.2a

THE SECOND STAGE
(1908.5 - 1921.2)

Main industry:

Iron for shipbuilding, alchohol, cement, fertilizers

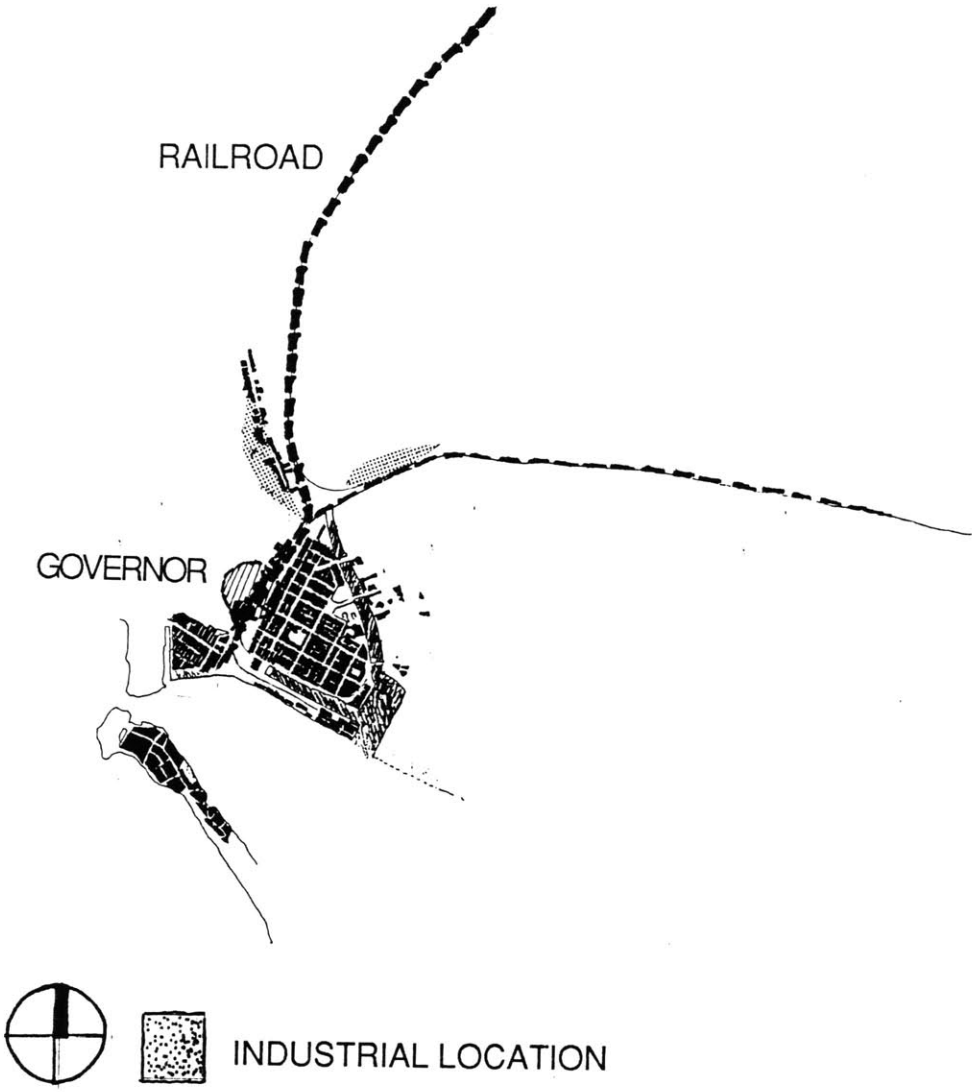

Fig.2b

THE THIRD STAGE
(1921.2 - 1932.10)

Main industry

Foods, cans, soap, ice
agricultural implements,
automobil production

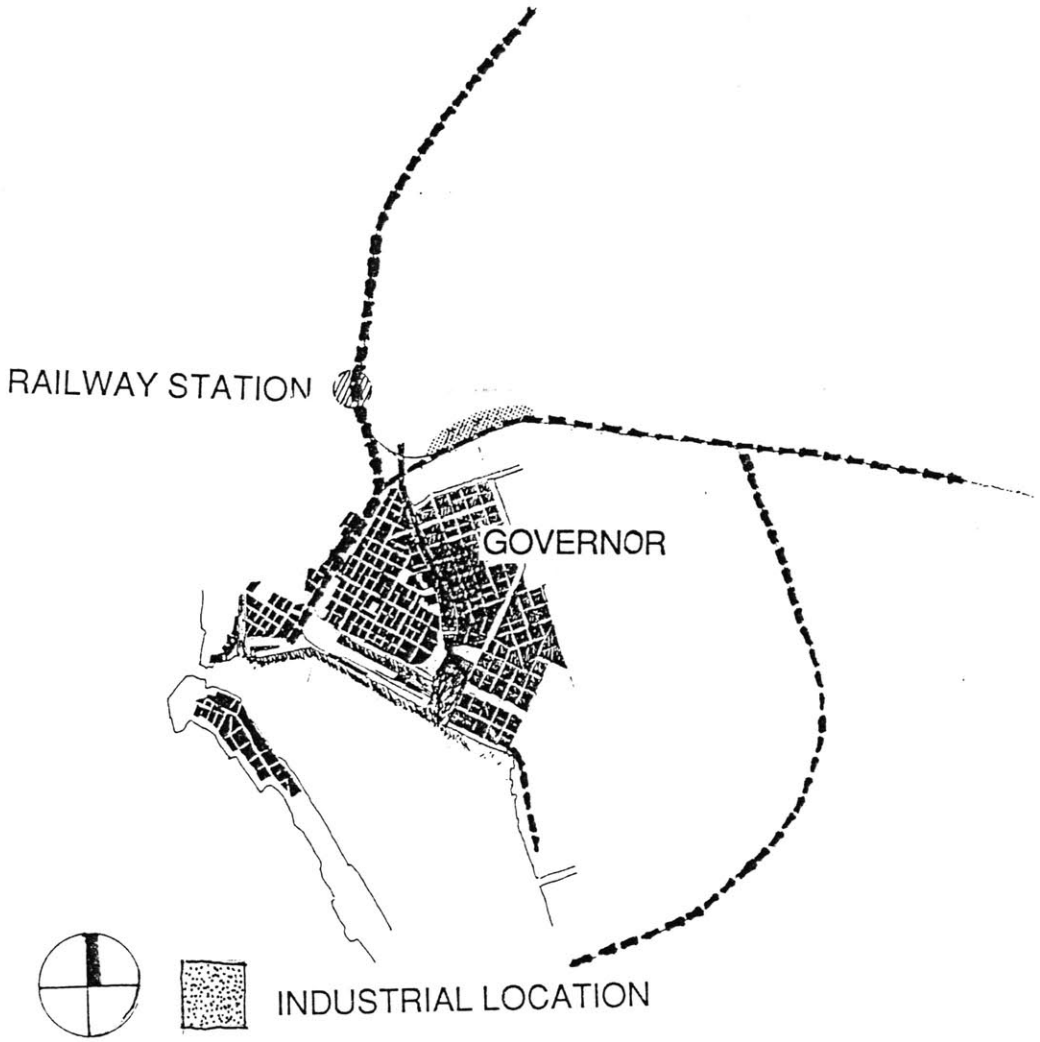

Fig.2c

THE FOURTH STAGE
(1932.10 - 1945.8)

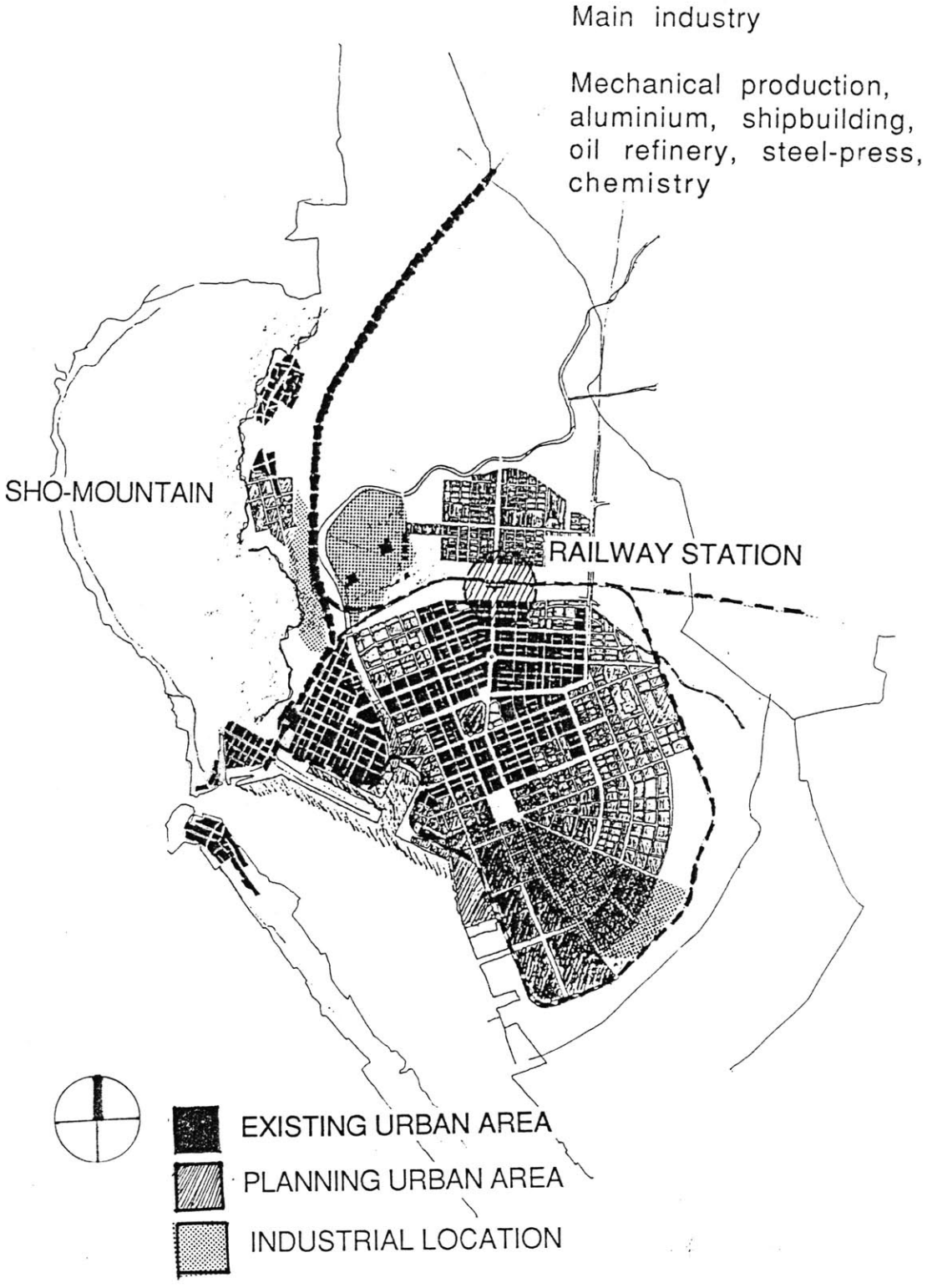

Fig.2d

AFTER RECOVERY
(1945.8 - 1945.11)

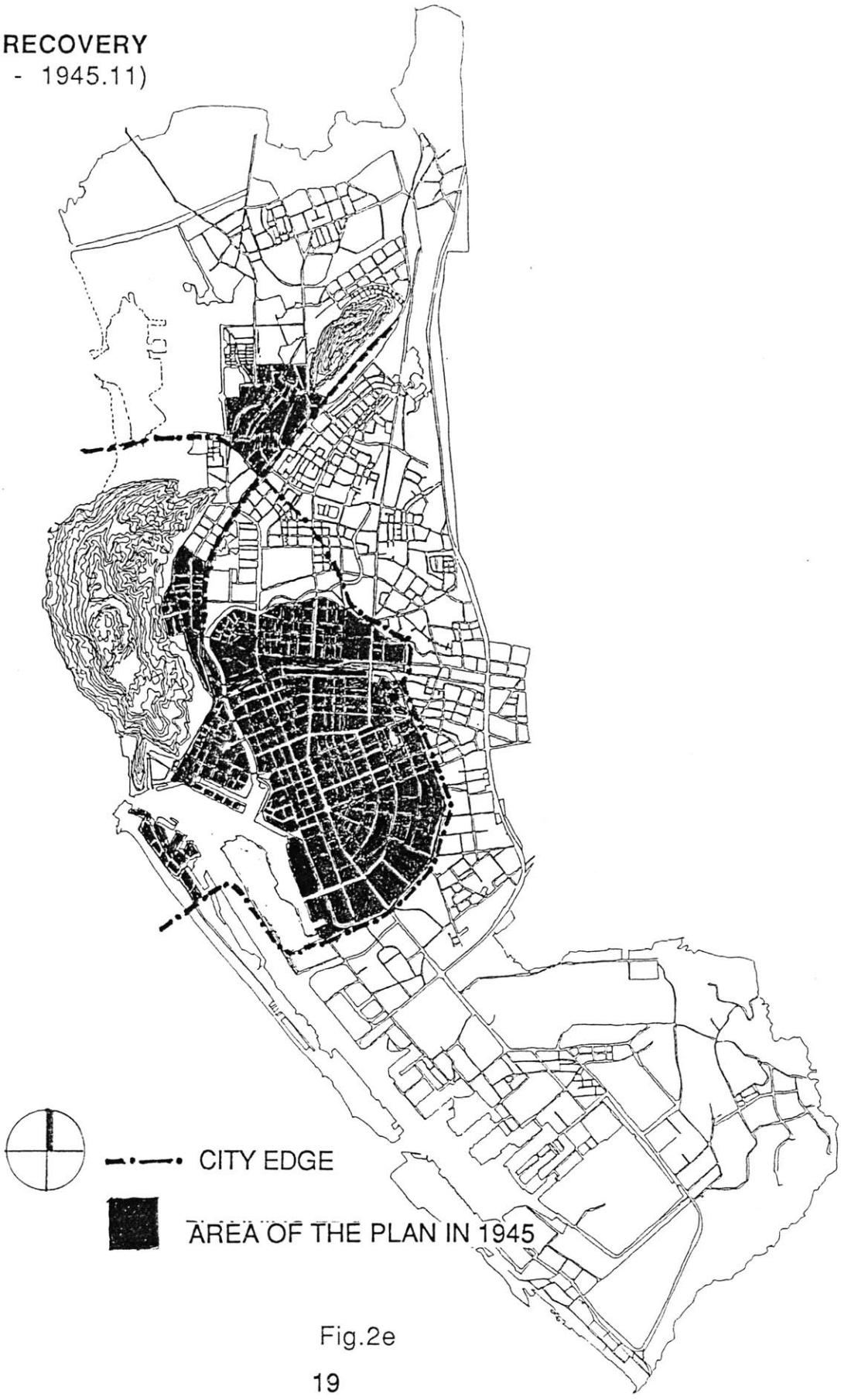

Fig.2e

1.3 PLANNING OF THE INDUSTRIAL AREA IN THE PERIODS DURING AND AFTER JAPANESE RULE

The distribution of the industries in the urban areas followed different principles in the four stages of the period of Japanese rule. In the early stages, the configuration of the industrial areas followed the existing land use rather than changing and replanning it.[1] Later, the planning of the industrial areas was more strategic in order to match the Japanese offensive on South Asia in the Second World War. Chen-Gen and Nai-Wei were two main heavy industrial areas planned in the later stage of Japanese rule. The demand for military industry formed the radiating street pattern (unlike the gridiron street pattern within the central urban area) in order to achieve efficiency in the transportation of products. This industrial area, along with the railway, formed the south edge of the city core. In the urban planning of the fourth stage, "unzoned districts" were set up on the edge of industrial areas for the mixed use of the industrial and residential or commercial lands (Fig.3).[2]

The planning and land use within the city core after the recovery almost follows in the footsteps of that of the period of Japanese rule. The large-scale industrial developments brought about the economic

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[1] The Japanese government started urban planning in Taiwan in 1932 for the first announcement of the planning of Koahsiung. Before that, the urban planning was only a partial readjustment plan of the urban area with a rough zoning area according to the existing use.
Wu, Ching Sheing, Research of City Planning and Growth of Taiwan in the Japanese Rule Period, p.113.

[2] See Fig.3.

source :

Wu, Ching Sheing, Research of City Planning and Growth of Taiwan in the Japanese Rule Period.

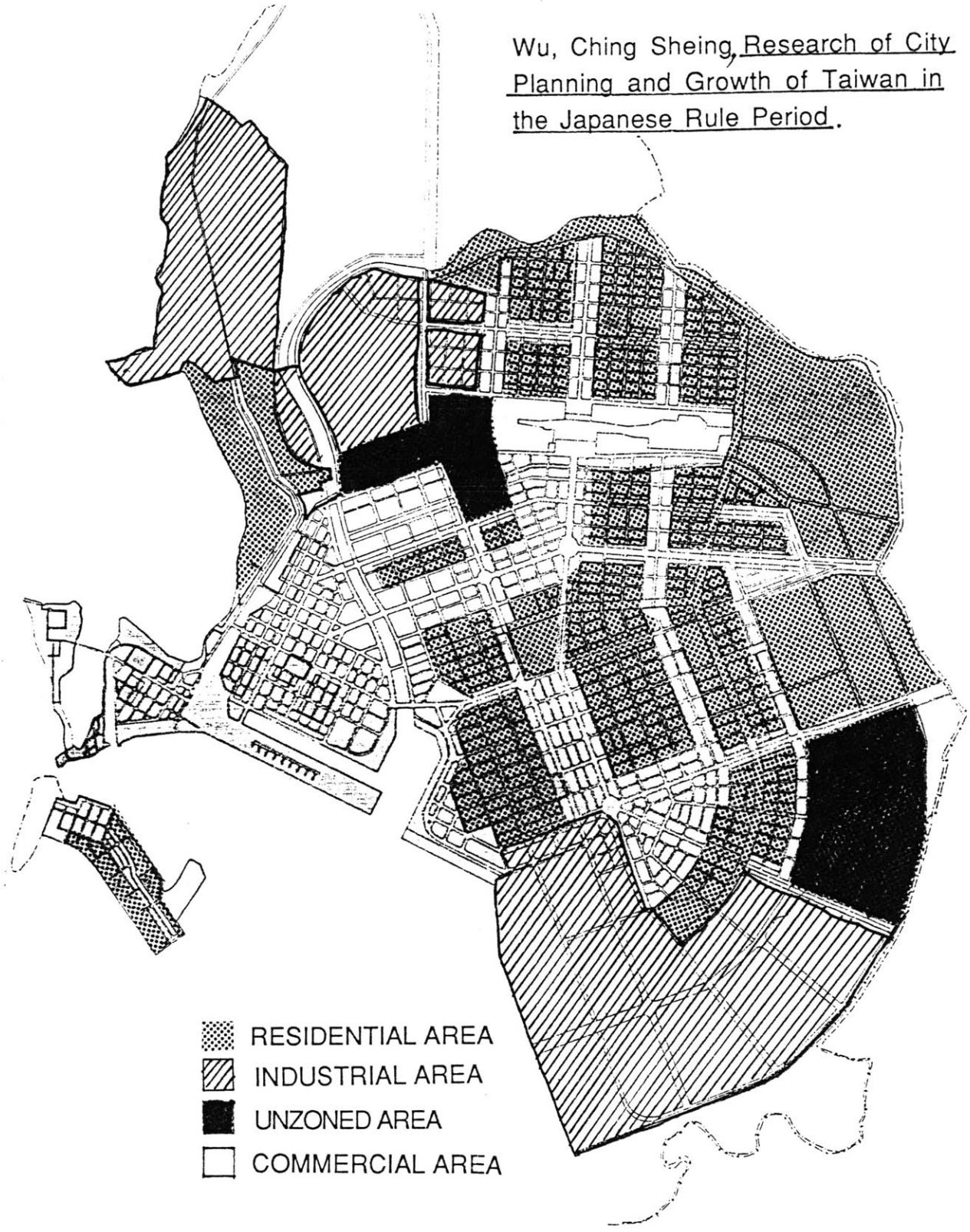

Fig.3 Land Use of the Late Period of Japanese Rule

development of the city and also accelerated the urbanization of the city. The build-up of the Nan-Zue high-tech industrial processing district in 1973, the construction of the second harbor in 1975, and the development of coastal industrial districts in 1976 were strategic developments in those areas. The other industrial locations which were set up within the urban area followed the formation of fragmented industries in a leap-frogging pattern. These areas are concentrated along the sides of freeways and on the edge of the central urban area. After the redistribution of the centers of industrial production, the small, family-run industries spread into different zoning areas, forming an invisible frontier within the central urban core.

CHAPTER II .

THE INDUSTRIAL BELT : Koahsiung's Inner Frontier

2.2.1 CURRENT ISSUES OF URBAN GROWTH IN KOAHSIUNG

When the city faces the pressures of urban growth, the industries in the urban area are challenged and their existence reevaluated in the urban context. The strengthening of employment and information services led to the continuing growth of the population of Koahsiung. The growth of the city stimulated urban redevelopment, but a dilemma was caused by the dual nature of economic functions and the degradation of the environment around industries. To consider the issue of urban development in Koahsiung, one must first consider the impact of the industries in the urban area, since the conflict of the industries and people in the urban area is accentuated by the urban growth and can no longer be ignored.

The population of Koahsiung grew from 662,202 in 1966 to 1,302,849 in 1985. Koahsiung harbor provides a great opportunity for the growth of business and transportation services and for exploring the potential of the industries in the city. The growth of the city's population can be revealing for trying to understand the growth of the city itself.

In the period between 1967 to 1970, the population growth of the urban area was 6.4%. From 1972 to 1976, the growth rate was 4.3%. Then it decreased to 3.5% from 1976 to 1980. Until 1985, the growth rate was

2.01%. This phenomenon shows that the population growth in the urban area reached a saturation point during the urbanization process and lead to the flow of population out of the city. There are three types of population growth patterns within the urban area. In the first type, the ratio of population of the area to the metropolitan area is continuing to go up. Sang-Ming Chu,[1] Cheng-Gen Chu, and Ling-Yar Chu are the main areas of this type (Fig.4). In the second type, the rate of changes in the area is going from decreasing to increasing. Nan-Zue Chu and Shauw-Gung Chu are the main areas of this type. In the third type, the ratio of the population of the area compared to the metropolitan area is continuing to decrease, as in Cheng-Ging Chu, Yeng-Cheng Chu, and Shing-Shin Chu. These areas were developed in the early years of the period of Japanese rule.[2] We can observe that the population started to move toward the south and north of the city core as a result of expanding urban development.

2.1.1 GROWTH IMBALANCE

Pre- and post-recovery development divided the city into three parts. Nan Zue Chu, a large-scale oil refinery industry with its employee community, formed in the north of Koahsiung City. The construction of the Show-Gong industrial zone in 1979 and the linking of the harbor and airport concentrated the urban activities around the south where much of the recent urban development had occurred (Fig.5). To the north of

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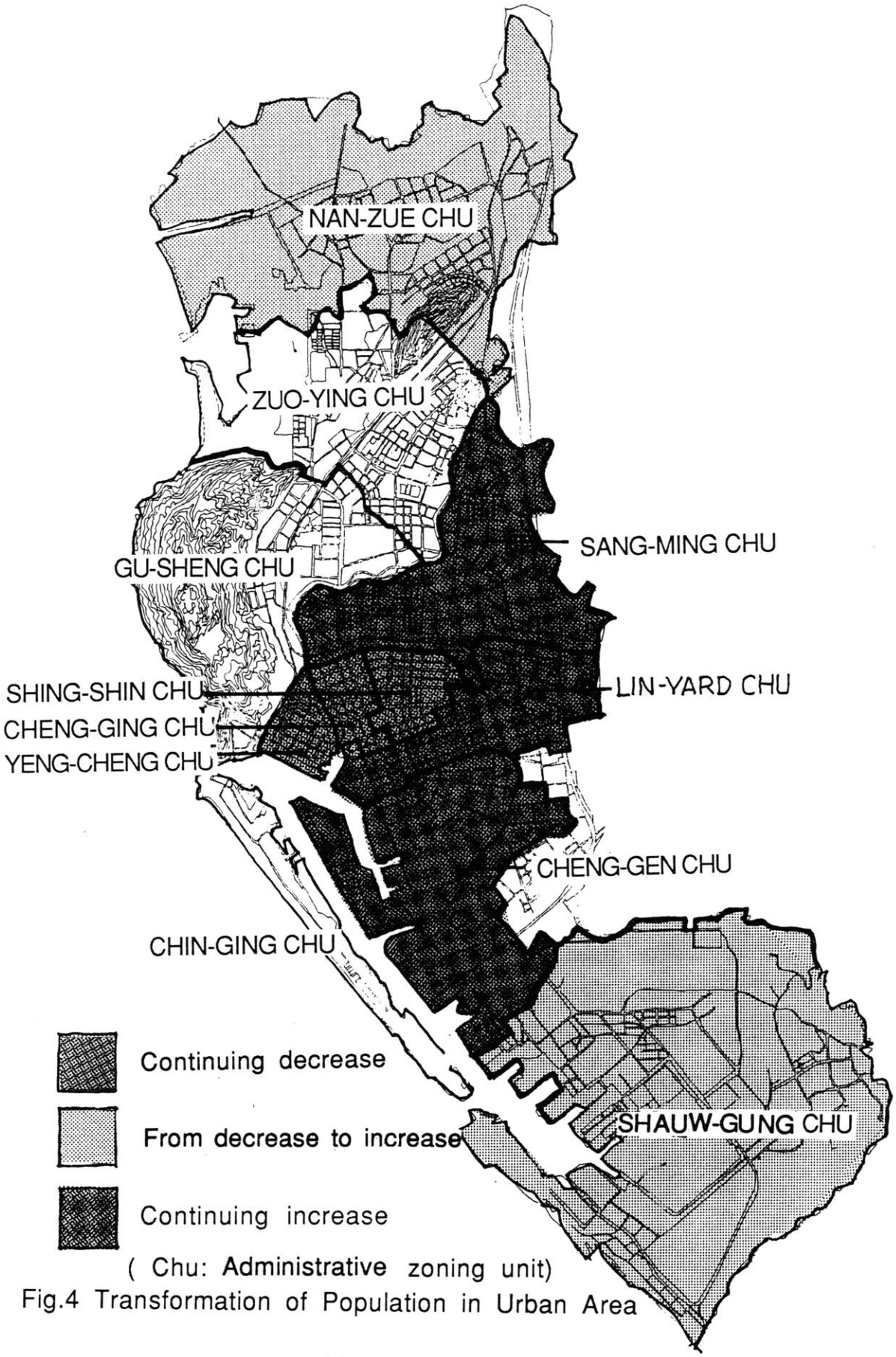
[1] "Chu" designates an administrative zoning unit.

[2] Chang, Chung-Ming, Study of Residential Spatial Structure in Koahsiung Metropolitan Area, Graduate School of Urban Planning, Jung-Shing Univ. Thesis 1987, pp.27-35.



(Chu: Administrative zoning unit)

Fig.4 Transformation of Population in Urban Area

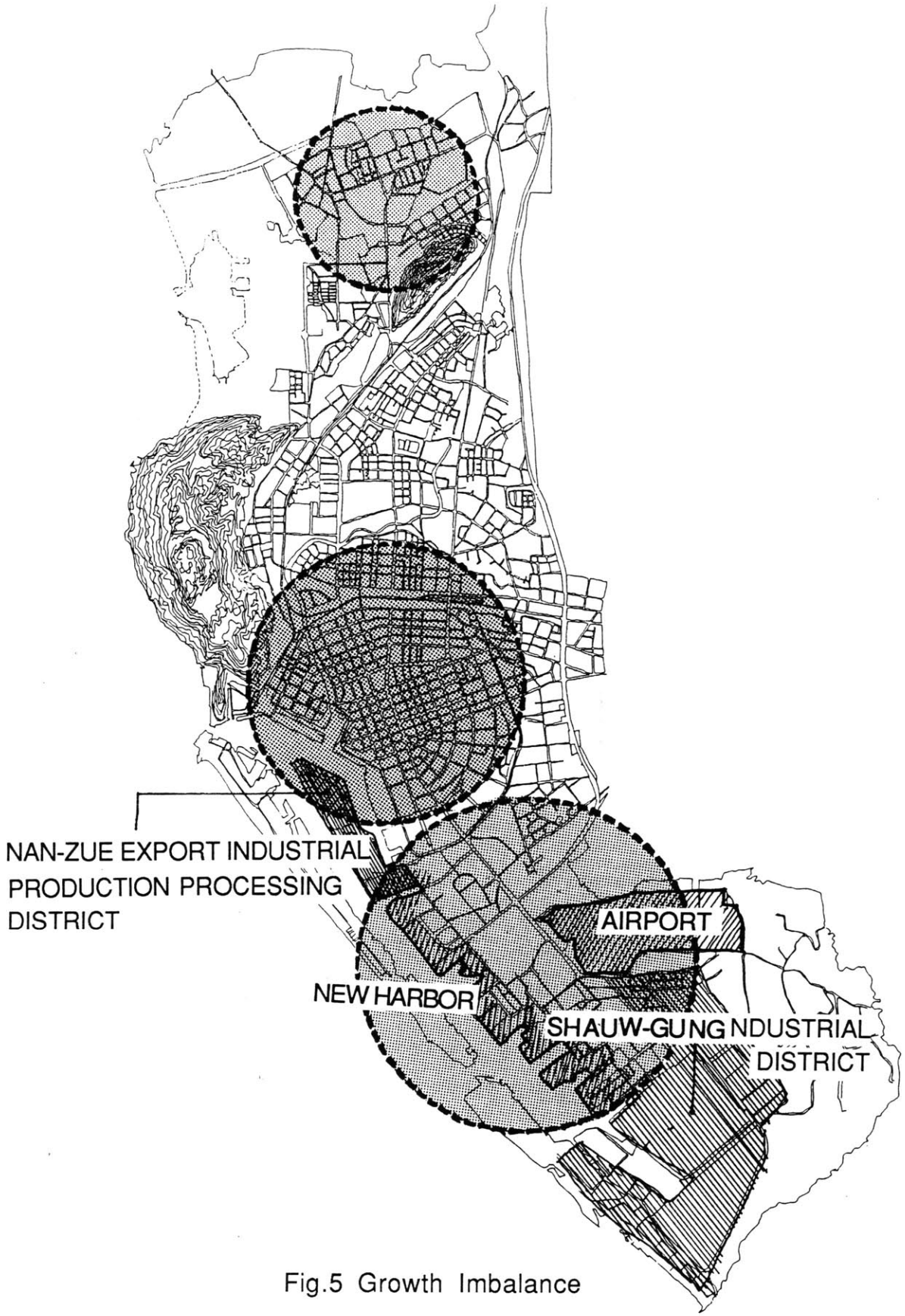


Fig.5 Growth Imbalance

the city core, the area crossed by the railway and the Gen-Eai River is bearing the pressures of city growth but has not been selected to play a role in the urban development (Fig.5).

There is a growing imbalance between growth in employment and growth in housing supply.[1] The centralization toward the southern area of the city has aggravated the traffic volume and boosted demand in the residential area. The congestion in the city core reveals the strong demand for residential space.[2] Redeveloping the area to provide residency and employment opportunity between the city core and the northern area could balance the regional development of the city and intensify the urban resources as a way of inducing the restructuring of the urban environment.

2.1.2 URBAN INDUSTRIES

The large-scale industries are distributed in several areas. They have formed their own borders in the areas around the factories after being there for a long period of time. The cement industry is close to the Sho Mountain for easy access to raw materials and for convenience of transportation. Taiwan Aluminium Industry and Taiwan Plastic Industry

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[1] See Table 3: Comparison of the residential and employment of northern and southern area of Koahsiung. Total residential / total employees= K (average residential area per person). The total residential area demand for the employee in southern area is 463641 ha / Existing residential area 302652 ha.
In the northern area Demand 363630 ha / Existing 302855 ha.
The total residential area should be increased in the other areas to feed the need of employees in the southern area. Chang, Jung-Ming, Study of Residential spatial structure of Koahsiung Metropolitan Area,1987.

[2] See Report for Kohsiung Auo-Zuedi Sub-city Center Development, Graduate School of Civil Engineering, Taiwan University, 1987, Introduction1-1.

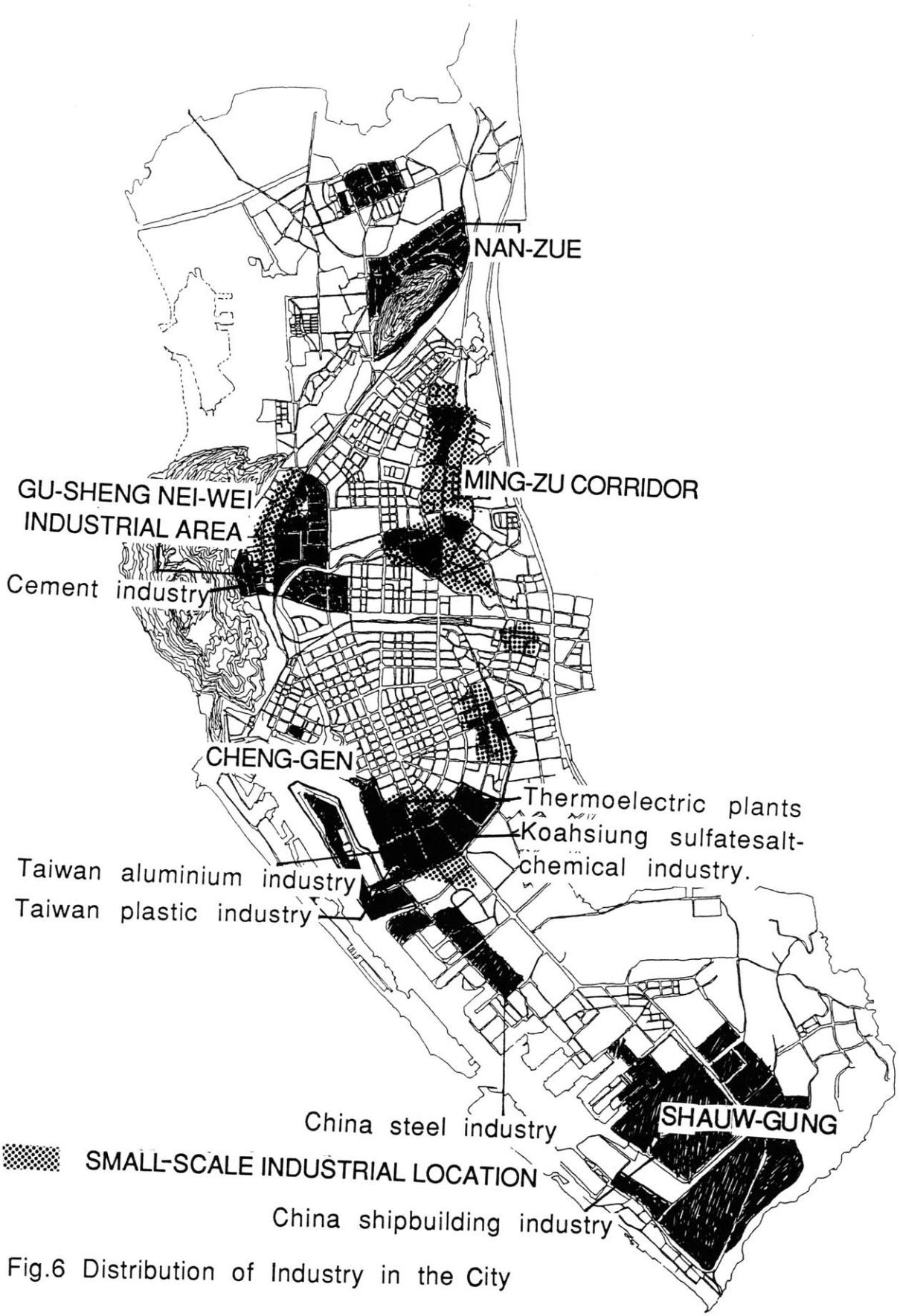

Fig.6 Distribution of Industry in the City

are both located within the Chen-Gen Chu close to the local railway. China Oil Refinery Industry established its headquarters in the northern part of the city. The shipbuilding and steel industries are located in relation to the harbor and the airport. The small-scale industries are located around the peremeter of the city core, perticularly in the area between the railway and the expresswar to the north and along the railway at the southern edge of city core (Fig.6).

Most large-scale industries belong to the public sector. Both of the industrial areas are in themselves well-planned from a land use point of view. Because the big industries offer ample employment opportunity and attract a large population from the surrounding community, they have gradually formed an industrial neighborhood complex. [1]

The categorization of the industrial locations within the urban area is defined in the report, Evaluation of the Industrial Development and Choice of Location, by the City Planning Department of Koahsiung, is shown in Figure 6.

Cheing-Gen:

This area covers part of the city core and most of the harbor and hinterland. This is the most seriously polluted area in of all of the industrial areas, because most of the large-scale heavy-polluting

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[1] The classification of industrial scale is according to the no. of employees: Largest scale: >500 persons, Oil refinery & coal production industry.
Middle scale: 100-499 persons, Metal industry (110, 225 persons)
Small scale: 0-99 persons. Transportation tool repair industries, paper & print industry, cloth & spin industries, leather & fur industries (25 persons).
See The Republic of China Labor Force Statistics Monthly Journal, 1979, 1982, 1983.

Fig.7. Industries and housing in the Cheng-Gen industrial area

Fig.8. New housing developments in Cheng-Gen Chu

industries in Koahsiung are gathered together in this area. Since this industrial location is the closest to the city center, and since the housing demand of the central urban area is great, the industries have come closer to people's everyday lives (Fig.7).

There is an industrial processing export district, located in the harbor area, for the production of electronics and appliances. The main large-scale factories in this area belong to the Taiwan plastic industry, the Taiwan aluminium industry, the thermoelectric plants, the Taiwan machine industry, and the Koahsiung sulfatesalt-chemical industry. Those industries are severe air and water pollution sources, and they endanger the lives of people in the surrounding residential areas and the lives of their own employees.

In recent years, land prices in this area have risen considerably compared to the other industrial areas, since its location and the street pattern offer a good connection to the city center.[1] Booms in the urban market have lifted the land price of the area inside the original urban edge (the railway). This is especially true in the residential area facing the main street of the city, Chong-Sheng Third Road. The southern area, which is zoned for industrial use, is used for industrial transportation, storage and agriculture. Some of it has been converted to residential use because of the expansion of the city. The polluting factories are all concentrated in the northern area inside the railroad. A large amount of private development (such as high-rise buildings)

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[1] The statement is according to personal observation of the area: high-rise and luxury housing projects are built on the land and replace the originally vacant land.

takes place in the vacant land adjacent to the factories and is offered at a high price. The residential towers stands in close to the factories indicating the strong demand for urban land (Figs.7,8). The dangers of the chemical factories haunt the neighborhood. (Fig.7)

The percentage of the industrial area developed in the whole industrial zone is 43.3%. The percentage of public land in the industrial area is 35.3%. The open space for parks is only 0.7%. The other public lands are roads, water land and storage land. The water land, used mainly by the industries, is seriously polluted.

Ming-Zu Road Corridor:

This area is located just outside of the heart of the city. It is a transition area between the high-density city core and the edge of the city. The area is bounded on one side by the upper stream of the Jen-Eai River and on the other side by Ming-Zu Road, which is one of the main freeways connecting the city to other cities (Fig.9a). Convenient transportation and the large amount of vacant land beside the river make it an ideal place for the illegal factories to gather (Fig.9b). The chaotic image of the area reflects the rapidly changing character of the location and offers an indication of the second expansion of the city since the recovery.

52% of the factories in the Ming-Zu Corridor are illegal. In this area most of the people live and work in the same place; the living quality of the area is poor and the pollution of the factories is out of control. The main industries in the area are metal production and transportation

Fig.9a Ming-zu corridor

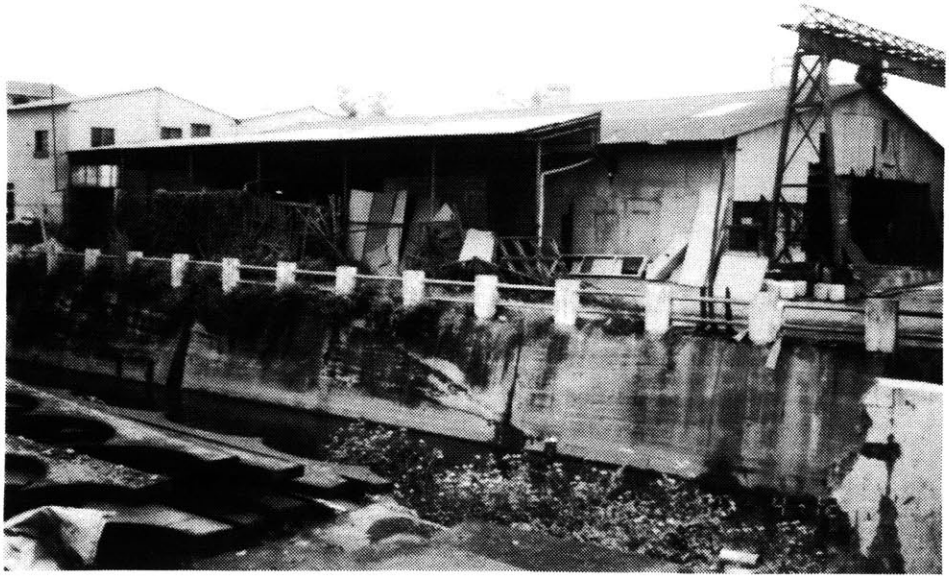

Fig.9b Factories beside the Gen-Eai River

Fig.10a Street View of the district beside the Sho Mountain

Fig.10b View of Sho Mountain and Gu-Sheng Chu

tool repair. There is serious pollution in the natural resource there--the water land. The river is one of the main resources of open space and makes a view of the city possible.

Some of the factories are planning to move out of the city and into the industrial zone because the industries are restricted from expanding in this area. The area still has a serious problem in mixed-land use of small-scale industries in residential areas.

Gu-Sheng Chu in Nai-Wai district:

Gu-sheng Chu has been developed since the second stage of the period of Japanese rule. Mechanical production and the cement industry are the main industries in the area. The area is connected to the old city commercial center, Yen Cheng Chu, and the political center in the Koahsiung area before the period of Japanese rule, Zuo-Ying Chu.[1] There is also a string area located between Sho Mountain and the railway (Fig.10a). Sho Mountain is the main source of raw material for the cement industry (Fig.10b). The decaying of Yeng-Cheng Chu and Zuo-Ying Chu prevented further development of the area.[2]

The lands surrounding Nei-Wai Lake on the eastern side of the railroad (opposite Gu-Sheng Chu) are now vacant and filled with illegal

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[1] Zuo-Ying Chu has been a political center since the Ching Dynasty.

[2] Yeng-Cheng Chu used to be the commercial center in the period of Japanese rule, but the area began to decay while the commercial center was moving toward the east.
Zuo-Ying Chu has become a concentrated military post because of its strategic location on the coast.

factories. The lake is meant to offer an open space for the city, but now the water is tainted by the industries on the land (Fig.11a).

The unplanned nature of the Nei-Wei area not only impeded the extension of city development to the Gu-Sheng Chu, but turned one of the largest green spaces of the city into wasteland. Nei-Wei Chu was planned as an industrial zone. It extended across the Jen-Eai River, then stretched to the west of the river, forming a complete industrial belt with the cement industry (Fig.11b). The industrial development rate for industrial land here is 34.2%, the lowest in all of the industrial areas of Koahsiung city. A new plan for the industries is essential for further development of the Gu-Sheng Chu, and for protection of natural resources in the Nei-Wai district.

Neng-Zue:

This area is formed mainly by the oil refinery industry with its community of employees, and also by the cement industry. The separation between the industries and people's living environments is much better planned than in the other industrial areas, but the pollution caused by the oil refinery factories seriously damages the air quality of the area.

Shauw-Gung Chu:

This entire area is an industrial site developed by the government. The shipbuilding and steel industries are the main ones there. Within the area is also a community for the employees of both industries. The two industries are strategic ones and have better control over their

Fig.11a Polluted water of Nei-Wei Lake

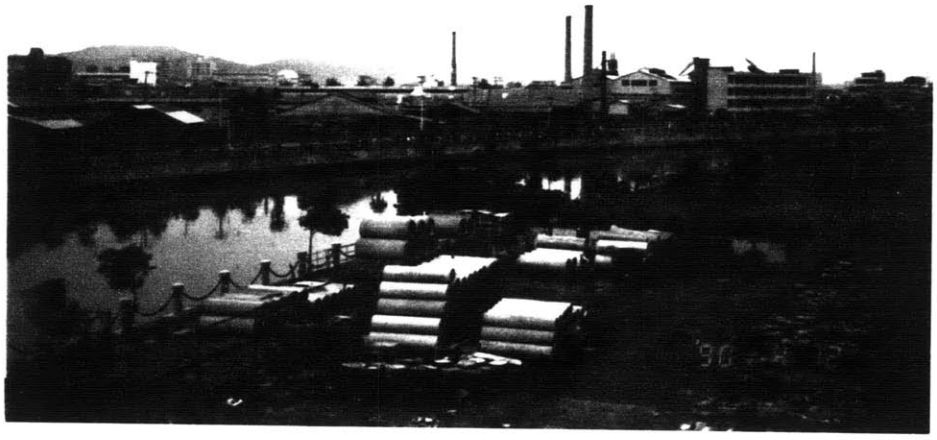

Fig.11b View from Nei-Wei Lake to Gu-Sheng Chu

industrial pollution than other industries. Therefore, they will not be considered for relocation out of the city in the near future. As the site is near the harbor and offers a good industrial environment, the feasibility of changing the land use of the area is low.

The large industries and the enviornmental protection groups have argued about relocation for a long time. It is also a dilemma for industrial development on Koahsiung City, but there are other factors which outweigh the enviornmental concerns. Firstly, almost all the large-scale industries are located in complete and well-planned industrial sites. They have generally formed their own frontiers away from the central urban area and have not yet caused a face-to-face confrontation with the urban development of the city. Secondly, The removal of the large-scale industries involves problems mainly based on economic concerns[1] which are not the focus of this thesis.

The small-scale industries, which spontaneously spread in high- and low-density urban areas, have a strong influence on the current urban development of Koahsiung. Because of their small scale and the fact that most of them are informal and are combined with people's living spaces, the industries are a strong presence in the central urban areas. The most common process of evolution of the small-scale industries in the urban context involves an aggregation of points to a plane, then the gradual erosion of the surrounding area, and finally the formation of the frontier (Fig.12). We will observe the formation of the frontier and

[1]These considerations focus on the cost and return analysis about the factories' construction and facility costs, and the acquisition of large pieces of land for factories.

the interaction of different industries with people, using this as a basis to outline the combination of industrial production, people, and the central city.

Fig.12

2.2. THE INNER-CITY MIXED-USE DILEMMA

Small-scale industries have always played a key role in the urbanization of Koahsiung and are the main form of informal production. Since the period of Japanese rule, they have supported the city economically; physically, they have formed the visible perimeter of the city, an urban edge of pollution and cheap land. The division of the industrial production structure determines the distribution of small-scale industries in the urban spatial structure. The small-scale factories are scattered over the urban area as a result of the restructuring and fragmentation of the systems of production and the loosening of industrial regulations. These industries need the least labor but can satisfy the demand for variety in production. However, they have the least flexibility in adapting to economic or physical changes. The home factories are the most basic units in the whole production division structure. In the flowchart of industrial productivity--the production process from raw materials to the market--the small industries are the active structure mediating between the upstream and downstream industries (Fig.13). Most of the private industries fall into the catagory of processing. Some of the private industries initially grew around the main industries of the area, which process raw materials to a formed state to be further

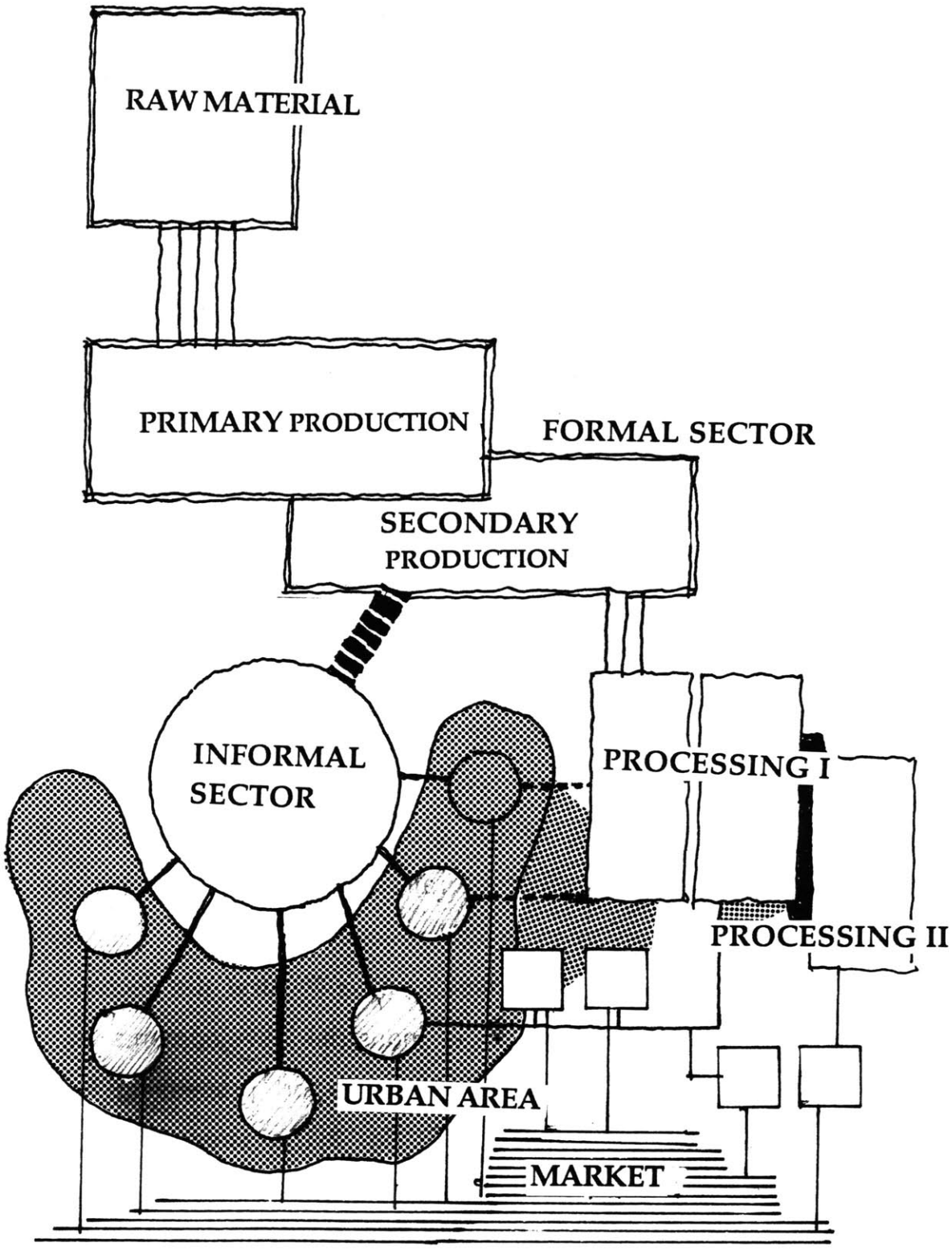

Fig. 13 Formal and Informal Industrial Production Relationship

processed. The conventional industries still give the cost of production the highest priority when considering the location of the factories.[1] When the transportation situation was improved, the cost of land became the main factor in choosing factory locations for the private industries. Sixty-five percent of the industries are illegal.[2] Low and middle income families involved in the informal center of production settle in the marginal land of the city or use their houses as work space to reduce the cost of production. In the analysis of the previous chapter, we saw how the movement of industries interacted with urban development. The economic relationship between the industries and urban spatial structures will continue to be played out when the industries start relocating within the urban area. Understanding the ecological process of the interaction of industrial productivity with the changing urban demand can provide a basis for decisions about the current urban development dilemma.

Anticipated change within the inner urban industrial territories raises the necessity of a new relationship between people and industry. Unplanned mixed land use in the Koahsiung industrial belt has resulted in the decay of both the industrial and human living environments. As Koahsiung requires more land to relieve the growing pressure within the urban area, the conflicts become more visible. The industrial inner land provides the physical evidence for studying the relationships

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[1] Storper, Michael, "Toward a structural theory of industrial location," Industrial Location & Regional Systems. Some of the factors involved with the production cost no longer determine the conventional industries' locations, but in developing countries like Taiwan, the cost of production still is the most important factor in setting the industrial location.

[2] See Table 4: No. of illegal factories in Koahsiung.

between small scale industrial production, people, and urban development. Then can come the replanning of the area as urban resources become accessible.

Some problems were raised in the urban area by the inner industrial frontier. Mixed use of residential space and industrial working space in the industrial areas degrades the environment for both living and production. The most common situation is that either residential units are illegally attracted to the factories, or industrial centers illegally parasitize living space. This can be observed from the distribution of illegal factories in the central urban area. In the residential area of Sang Ming Chu, there is an illegal factory for every 60 residential units.[1] This is because the laborers often live and work on the same site, and because the industry is often dependant upon other activities in the residential or commercial areas.

2.2.1 DEGRADATION OF THE PHYSICAL ENVIRONMENT: Mixed use of small scale industry and residency in the central urban area

There are three ways by which mixed use of small-scale industry and residential areas in the central urban area is formed:

A. Home factories--the result of the informal sector restructuring the industrial production system:

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[1] See Table 4

The most common type of small-scale industry in the central urban area is the home factory, largely a phenomenon of the so-called informal sector. The main reason for this fact is that joining the production space with the living space is an easy way to avoid the registration process and taxes. While providing a minor additional income for a family, the home factory makes it possible for women and retired people who cannot work outside the home to provide a light work force. They are the main labor force of the home factories which work on the processing of industrial products. Combining the working space with their family space is the most efficient way of satisfying both the demands of improving the families' financial situation and that of taking care of their families.

B. The formal sector industries within the old urban area:

The other small-scale industries within the central urban area, which had been on the edge of the urban area since the period of Japanese rule, became an impediment to development after the expansion of the urban area. Some had relocated because they could not afford the increased land prices after the area had been urbanized, but some remained on the land without upgrading their traditional facilities and production processes, and consequently brought down the land value of the area. These industries not only decrease the quality of the neighborhood but also form an impediment to urban development.

C. Frontiers in the new urban expansion area:

Some of the mixed-use patterns arise from the erosion of the small-scale industries--formal and informal--in adjacent areas. During

expansion of the central urban area, new small-scale industries settle in the marginal area by purchasing cheap land. These industries coexist with the spontaneous residential district. Then illegal industries start to encroach upon the neighborhood. The absence of effective regulation of residential-use areas in the zoning code leads to an inevitable rezoning of what was originally a residential-use area to one of industrial use. Relocating the original middle- and low-income residents in these areas without government supplementing the public housing by is still a questionable approach for solving the problem of mixed land use. The area between Sang Ming Chu, Gu sheng Chu, Zuo Ying Chu and Cheng Gen Chu is the main candidate for this approach.

Pollution is the most serious problem in this urban context of mixing fragmented industries with people's dwellings. The general description of this pollution is stated in the previous section. The most serious pollution of the air and water within the urban area is marked out on the map (Fig.14).

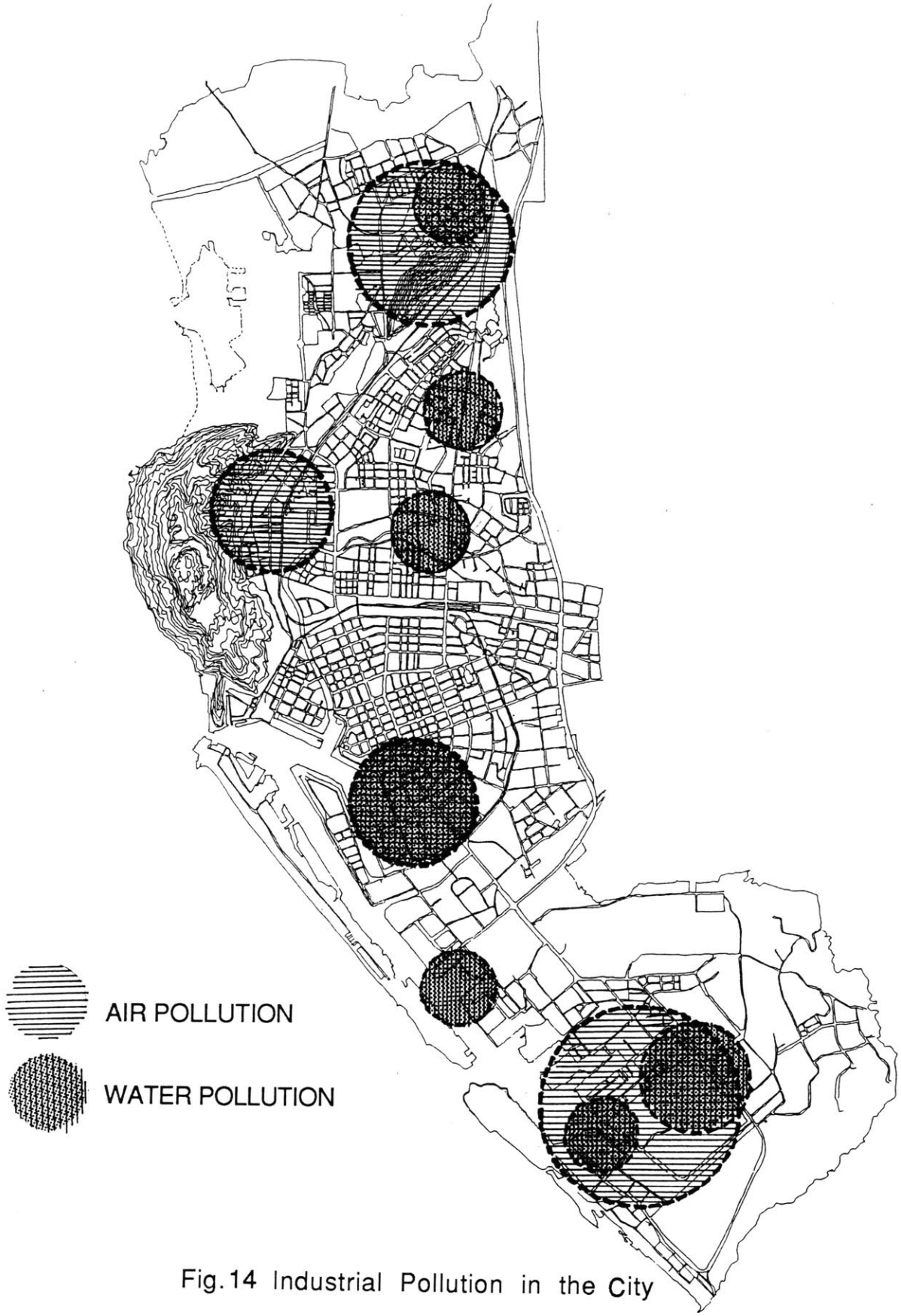


Fig. 14 Industrial Pollution in the City

2.2.2 DEGRADATION OF THE PSYCHOLOGICAL ENVIRONMENT

The infiltration of the small-scale industries (which convert residential constructions to industrial factories) into residential areas not only degrades the physical environment but also people's psychological environment. A good urban environment has to offer an atmosphere in which people feel secure and can be satisfied in their relationships with others. Neither of these conditions is met under the degree of mixed-use of industries and residential units. Mr. Wu, who has lived in the neighborhood of Ling-Yar Chu for twenty-five years, said:

> I can do nothing if a factory is built in front of my house tomorrow. I know the neighborhood would not be the same as before; my everyday life would change, and there would be noise and a mess in front of my house.... The thing that worries me the most is that there would be a lot of strangers around the neighborhood, people I have never seen before.[1]

Small-scale industries attract laborers from different areas. These people stay only temporarily in the area. They do not have to keep a neighborly relationship with the people in the community. This is the most important factor (after physical degradation) which keeps the small industries from assimilating with the residential neighborhoods and increases the other social problems within the residential neighborhood.

Another factor causing people to feel unsafe about their environment is the factories' everyday working schedule. The factories become "ghost

[1] Interview on Jan. 7, 1990.

towns" within the neighborhood at night. The factory grounds become unmanageable for the people who live in the neighborhood and do not function in those residents' living environment at all. The residents do not have a sense of the territory they live in as being a whole. It is the same in the case of the neighborhoods built before the factories. It is hard to maintain or even establish a sense of place for the people living there. This disconnected sense of place is caused largely by the degradation of environment due to the small industries.

2.3 SPATIO-FUNCTIONAL RELATIONSHIPS BETWEEN THE INDUSTRIES AND RESIDENTIAL AREAS

The reality of the interaction between industry, economic development, and people is revealed in the spatial arrangement of the industries and residential units or office buildings. We will approach the problem from an analysis of the two-dimensional plans, which comes from organic growth in the urban context, or from official plans. (Sometimes the official plans are predetermined by the urban growth itself.) We categorize all the situations by the division of territory--industrial territory and residential territory--into two classes. First are the separate territories, where the industries and living quarters are in separate sites. Second are the combined territories, where the industries and residences are put in a single site for economic or legal reasons.

In the first category, because of the separation, there are other forces which come into play between the industries and living areas. Some

come from regulated forces, such as the infrastructure of the city, but some are due to unregulated forces, such as the squatter settlements. These settlements become the link between the industries and the affluent housing, formal and informal.

In the second category, the industries and housing areas have a direct economic relationship. We choose two prototypes to study: one is a self-built factory with a single house. The other is a house built by mass-production and then converted to a home factory, having a closer relationship between industry and living quarters.

2.3.1 IN SEPARATE TERRITORIES

There is a rule in this category to define the relationship between the industries and the housing area: If there are open spaces between the separate sites, the space will be occupied by squatters. Thus, the squatters become a link between the industries and residential buildings (Fig.15).

The industries are located along the railway route, like the businesses, which cluster in front of the railway stations.[1] The residential areas are located on the side opposite the main industrial area. The railroad formed a belt between the industries and human settlements in the

[1] In the early development of industries in the period of Japanese rule, the railway was the main means of transportation for the industries, and was a significant boundary for the city edge.

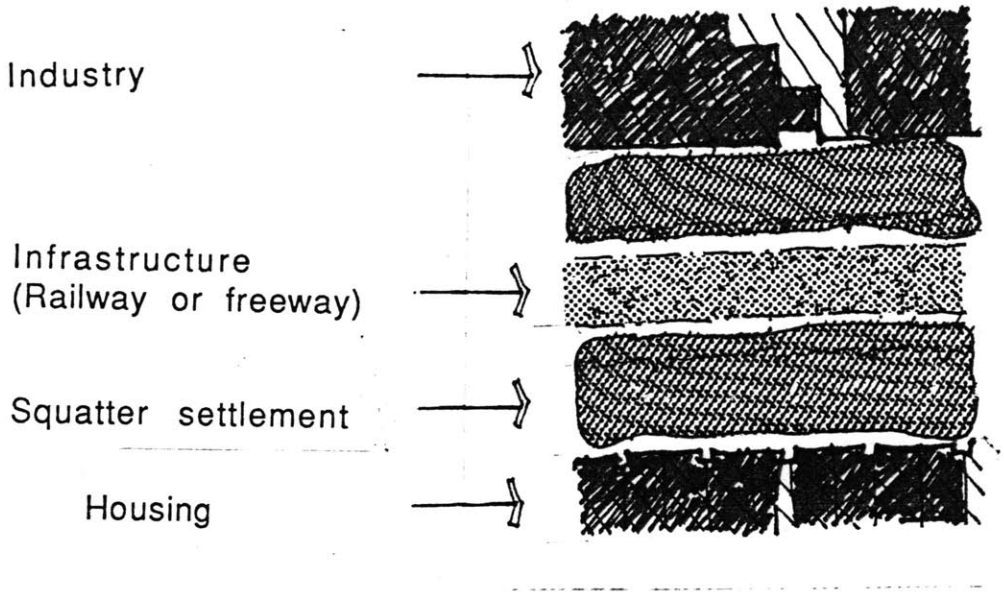


Fig.15 Buffer space between industries and housing

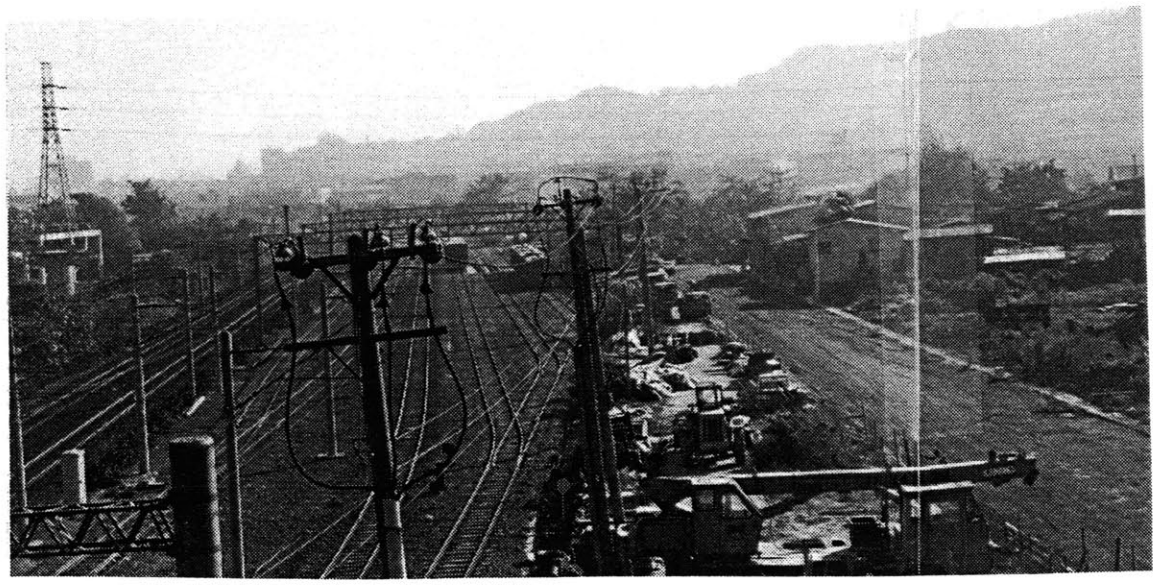


Fig16. View of the railway buffer space

early urban pattern. The other infrastructures, such as the freeway, are also integrated with the railway.

When there are extra spaces which are not controlled by the industries, private residential settlements, or by the government, the "third force" comes in to take hold of the land illegally (Fig.17a). Some of the squatter settlements are residential shelters, some are illegal factories. These structures break the boundaries between the industries and the housing areas. The squatters' dwellings also become a buffer space between the industries and housing areas.(Fig.17b)

2.3.2 WITHIN ONE TERRITORY

There are three relationships which will be studied on different scales. The first is the industrial community pattern. The second is the single house combined with a private factory. The third is the home factory within a group of mass-production housing.

A. Industrial community:

All of the three patterns are affected mainly by the economic relationships within the territory. Some of the factories offer housing for the workers. The efficiency of the connection of workers and factories and the low cost of production are two main considerations in planning the territory. The residential units are limited to a minimum in order to leave room for production space. As a result, there is no open space planned for the separation of residential units from factories.

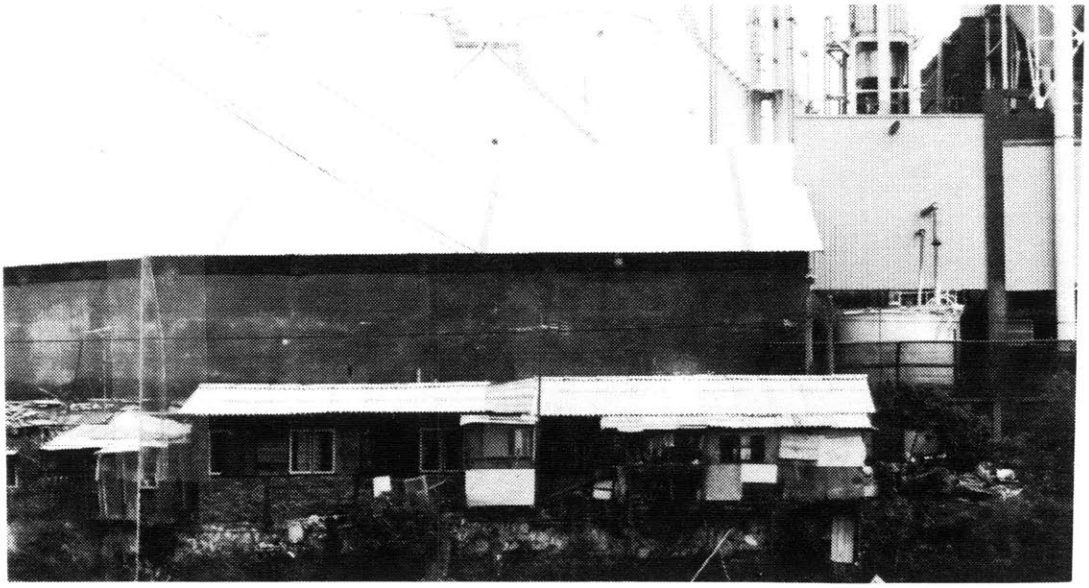


Fig.17a Squatters beside the industries

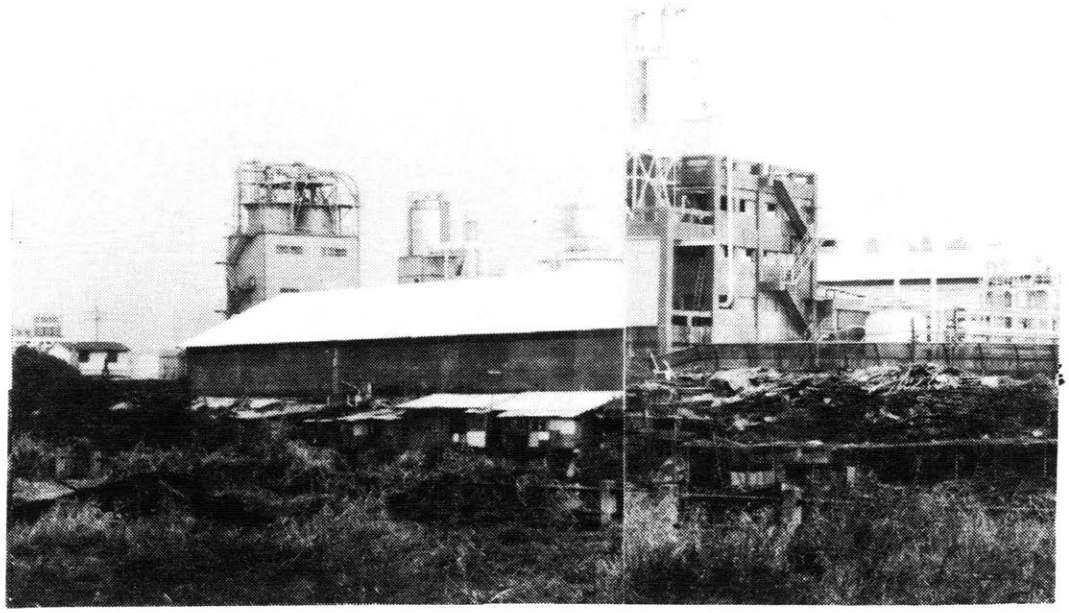


Fig.17b Squatters beside the industries

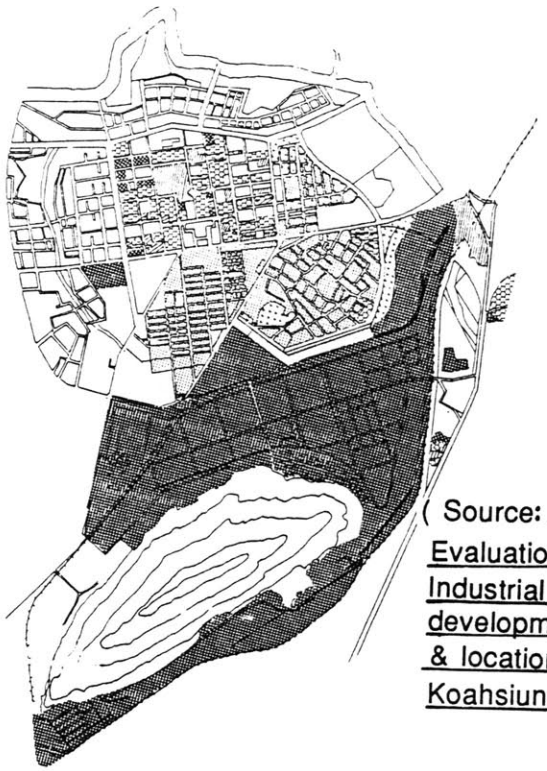
At this point I should mention one type of large-scale industry (even though it will not be studied here) because it provides an exception to this case. Some of the large-scale industries, such as the oil refineries and the ship-building industries, offer residential units to their employees, thereby forming a community (Fig.18a). The community has its own committees and governing system and becomes an independent site from the factories (Fig.18b). This case falls within the previous category of separate territories. The behavior and growth pattern of the industries, as combined with human settlements, will follow the rules of the relationships seen in the case of separate territories.

B. A complex mix of factories and private homes:

The house and the factory become a single economic entity in this case. Either the house was constructed beside the factory, or the factory (which may be legal or illegal) is built beside the house on the owner's land (Fig19a,b). This case is that of the family factory. Since the owners and inhabitants are the same persons, the relationship between the industry and the habitat has more buffer space and the conditions can be controlled. The owner of the land usually plants the connecting space with some vegetables or fruits, or uses the space for storage.

C. Home factories:

Most family industries are home factories because of the low production costs. The connection between industry and people is most direct in this case. People use the first floor as the factory and the upper floor for living space. This kind of home factory comes from the conversion of mass-production low-cost housing units. The rectangular



(Source: Evaluation of Industrial development & location in Koahsiung)

Fig.18a Plan of oil refinery industry and its community in Nan-Zue Chu

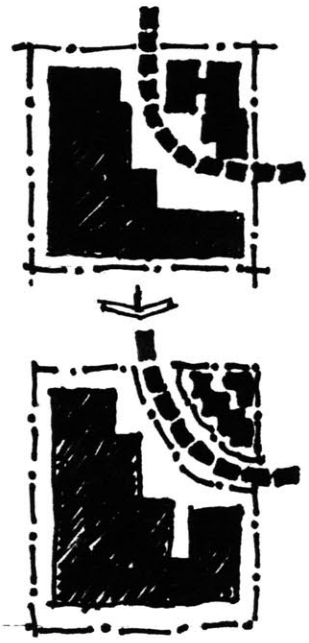
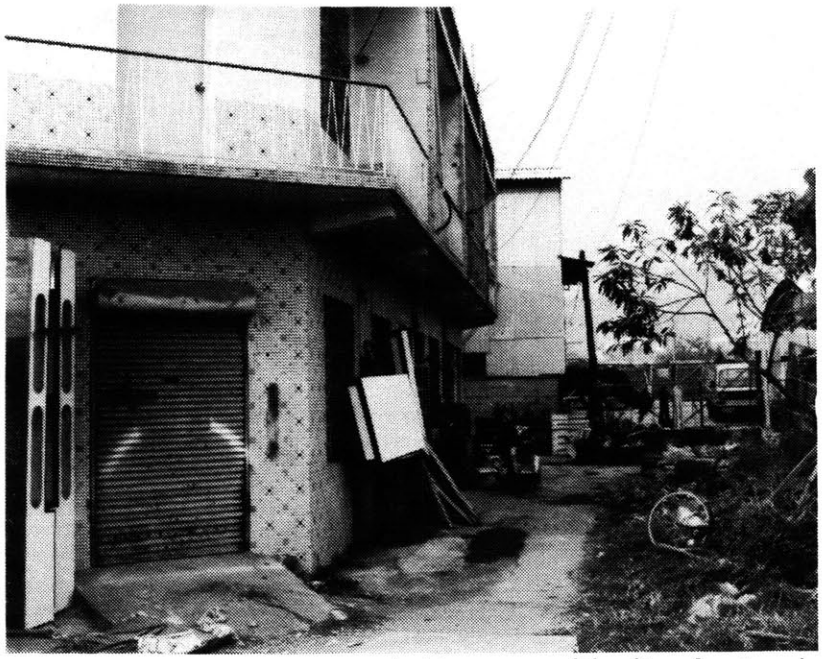


Fig.18b Changes of the territory



(House with its factory)

Fig.19a,b Buffer space within one territory

space which was originally designed for business, with its fluent connection to the street, becomes an economic space for small-scale home industries (Fig.20a). People work on the first floor and move their living space upstairs (Fig.20b).

The factors which control the relationships between the industries and the human settlements are economic. When the economic conditions change, the physical interaction also changes.

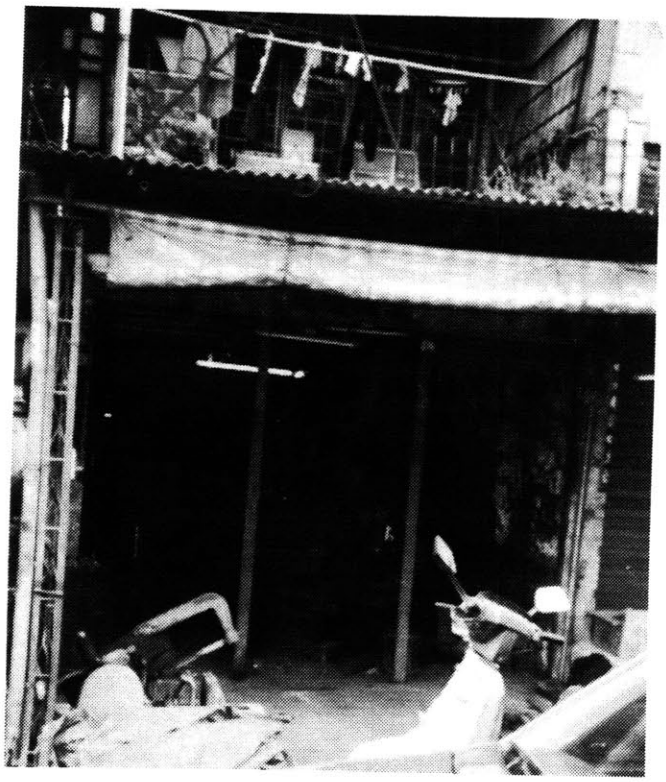
2.4 CHALLENGES

2.4.1 REMOVING THE INDUSTRIES

WHO SHOULD BE MOVED?

When considering the redevelopment of the central area or the expansion of the urban area, it is essential to redefine and replan the role of the small-scale industries within the city. What will be the standard for authorities to determine the relocation of the small-scale industries? Due to division in the structure of industrial production, the distribution of the industries within the spatial structure of the city is strongly related to the availability of labor, transportation, or land. Some of the industries have to mix with other land-use functions and zoning areas, but they also pollute the environment and are a public safety problem. What kind of industries can be left within the people's living environment, and to what degree? How would they interact with a new ideal living model?

Fig.20a Mass-production housing for home factory



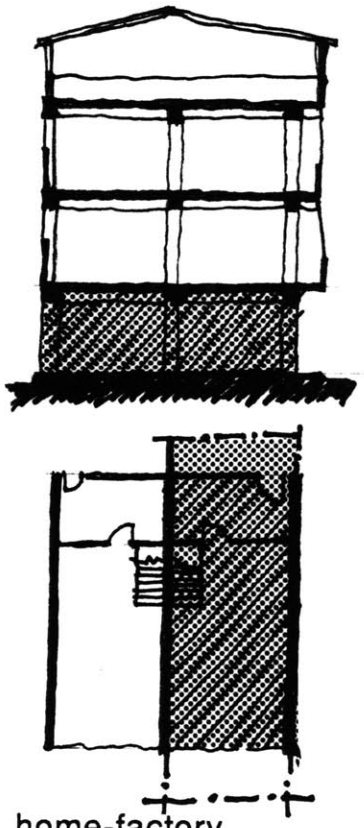


Fig.20b View from street to the home-factory

WHO HAS TO PAY FOR IT?

Since there is a close bond between the production process and living space in the home factory, relocating the industries involves a complicated negotiation process with the residents, who are also the owners of the industries. If the industries have to be moved after the evaluation of standards of environmental quality, who pays the cost of moving the factories? Most of the small-scale industries will not be able to afford the entire cost of this change because of their limited capital. Furthermore, forcefully relocating the small industries could possibly lead to their demise.

Another aspect is that the land value will go up after the redevelopment of the area. The middle- and low-income people and family factories might lose their homes. If the people cannot afford the increased cost of living, and cannot afford to buy or rent a house somewhere else, society has to be ready to help them. Although the informal housing/production system has been an important source of much needed housing in Taiwan, it also has served to decrease the housing quality and degrade the environment.[1]

The urban redevelopment process is the consequence of conflicts between different social classes. Redistribution of the social resources after every development stage is a way of preventing the conflict from becoming a source of social upheaval. Providing

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[1] Mi, Fu-Guoa, "Taiwan's Public Housing Policy," Taiwan: A Radical Quarterly in Social Studies, Vol.1, 1988.

reasonable compensation for the sectors which lose their assets in the development process can decrease the conflict.

If we take a macroeconomic view of the society, the whole urban system is an interlocking system formed of the different groups, which share all the profit and loss. The industries play an important part in the production system and support the whole economic structure, so the cost of degradation of the environment has to be shared both by the industries and people in the society. A share of the cost can be paid by the government, through taxation of the people. The benefit of upgrading the urban environment applies to all the people in the city. Further development and increase of the land value is the reward. Redistributing the social resources results not only in visible profit, but also in the wider scope of opportunities.

2.4.2 URBAN LAND USE CONFLICTS: Urban land use does not follow the functions of land in the zoning regulation, but vice versa

In the conversion of industrial land use within the urban area, there are two cases in which the zoning code is adapted to the existing land use. One is the case of industrial zones changing to other zoning areas, and the other is that of residential zoning changing to industrial zoning.

The first case often happens in the central urban area, where the conversion results from the growth pressure of the area. The small industries in the area agree to move out under the condition that the land used for factories be converted to commercial or residential use.

The other case usually happens at the urban edge, and has been mentioned in 2.2. In that case the encroachment of illegal factories on the residential area or the adjacent area results in the re-zoning of the area to the existing land-use situation. Reactive, accommodating zoning results from a vacuum of ideas, regulations, tools or enforcement mechanisms appropriate to the special growth pattern of small-scale industries in the city. Governing bodies must insist on the authority of zoning regulations and building codes in this urban evolution process. Enforcing a dynamic standard by setting regulations to protect the quality of life of the displaced residents might reduce the conflict now happening in the urban evolution process.

CHAPTER III

AUO-ZUEDI SITE STUDY: A Detailed Look

3.1 SITE FEATURES--A total view

A specific site is now introduced in order to study the relationship between industry and urban development. (Fig.a.b.c.) The area lies on the northern edge of the city core. It is bordered by Sho Mountain in the west, by the Ming-Zu Corridor in the east, by the Auo-Zuedi farm land in the north, and by the southern shore of the Gen-Aei River in the south (Fig.21b). This industrial inner belt has four elements which define the northern edges of the central urban center, namely Sho Mountain, Nei-Wei Lake, Gen-Eai River, and the Ming-Zu Corridor (Figs.21b,c). The three identities of Koahsiung City--The city core, the harbor, and Sho-Mountain--also form a basic spatial framework for the city's development in the future (Fig21a). This belt area is the battlefront of expansion in the central urban area. It not only is the focal point of new development but also offers an opportunity to study the phenomena and problems resulting from the evolution of industries and people in the urban area.

Retarded urban development, degraded environs, and a confused spatial order are the consequences of maintaining historical industrial production centers in the changing urban area. The district near Sho Mountain, the riverbank area and the area along the Ming-Zu Corridor provide evidence for this. The description of this site will refer to

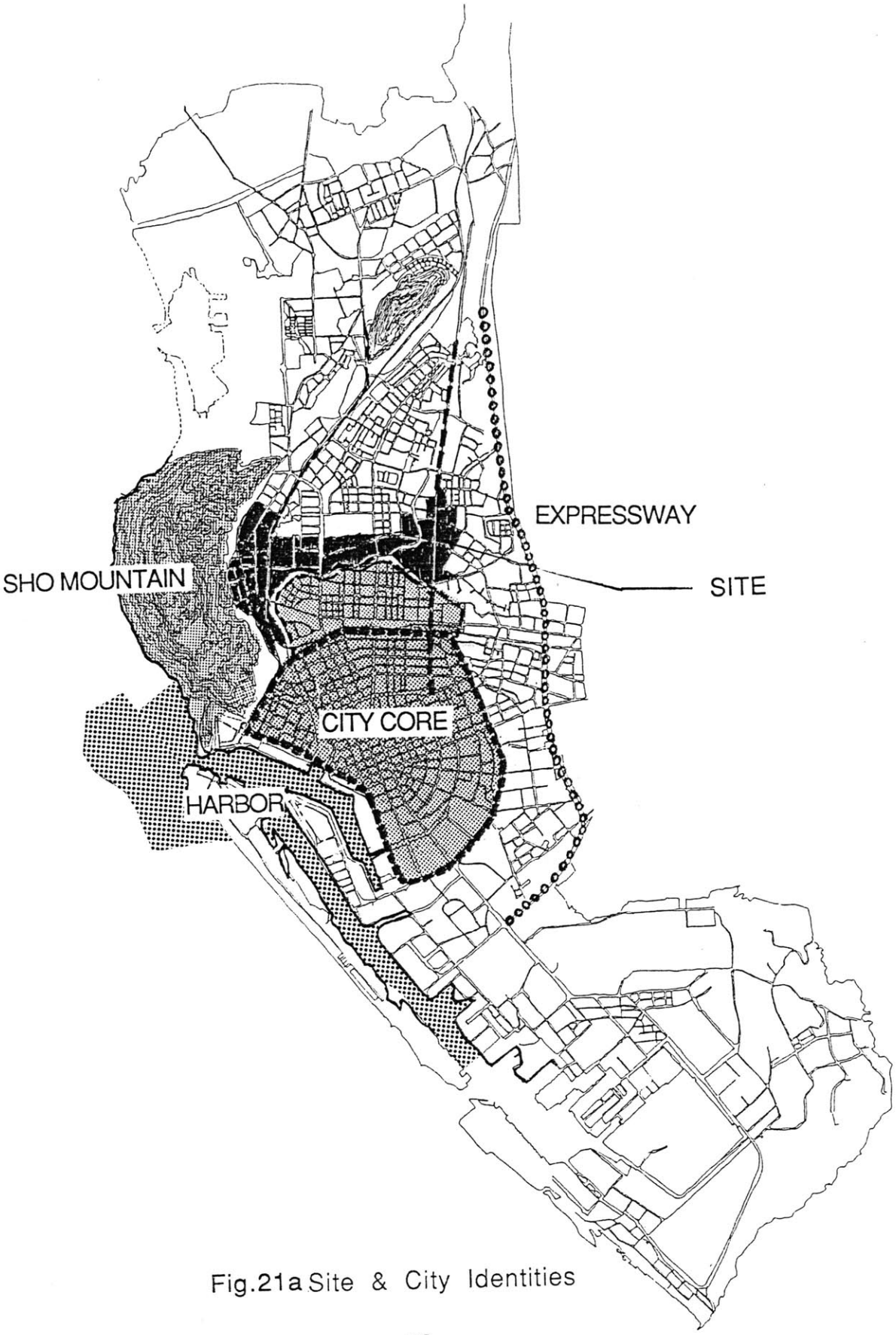

Fig.21a Site & City Identities

these three different features, which have different urban resources and time scales for development, but they will inevitably be linked together because, spatially, they have formed an industrial belt adjacent to the city core.

The Sho Mountain area:

The cement industry with its industrial community stands at the foot of the mountain (Fig.22a). It has a close geographical and visual connection to the mountain. The development of the area started in the period of Japanese rule. The urban texture has reached a dense state but is still low-rise (the highest building is about five stories).(Fig.22b) This area shows a clear decaying of the urban situation compared to the city core. The population continues to move out of this area,[1] and development of the area is slow. The decay of the Yeng-Cheng Chu[2] commercial district is one reason for this exodus; another is the prevalence of heavy industry, as well as the fact that the cement industry and the construction of the freeway has attracted many small-scale industries to the area.

The district has a clear linear form between the railway and the mountain. The railway offers buffer space of approximaty two hundred feet,(Fig.22c) separating the area from the land of Nei-Wei Lake. Figure 22d gives a clear view of this relationship.

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[1]See Fig.4 "Transformation of population within the city."

[2]Yeng-Cheng Chu was the downtown area in Japanese Period, but gradually decayed because the city center gradually moved toward the east, and the commercial district of the city core took over most of the commercial activities.

Fig.22a Cement industry beside the Sho Mountain

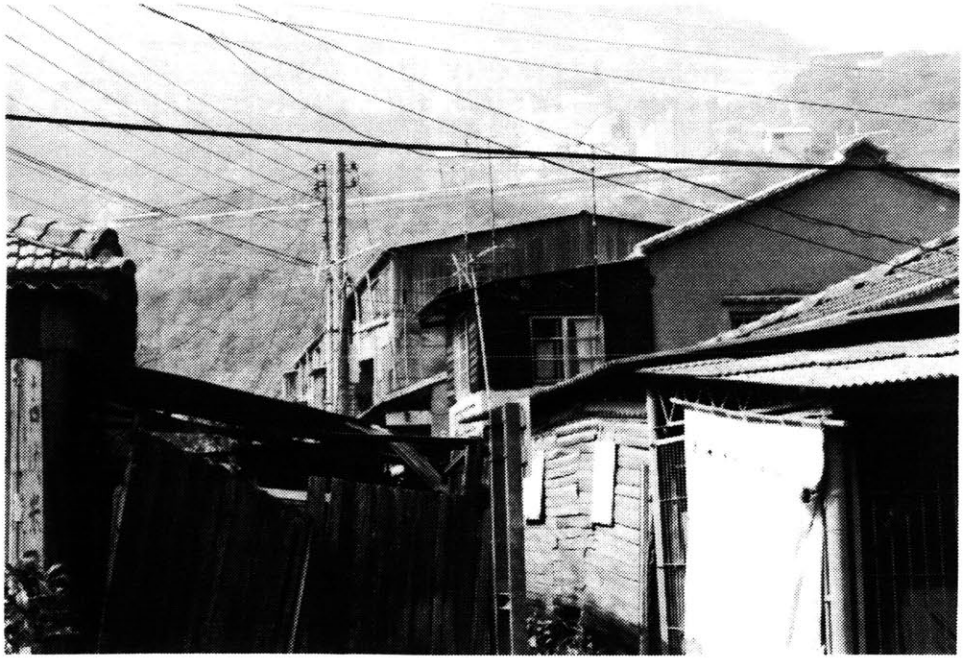


Fig.22b House on the Sho Mountain foot

Fig.22c Railroad space and housing

Fig.22d Section of the district beside Sho Mountain and the building

The cement industry is at one end of the district. The streets of the area are always covered with dust from the cement factories. When we look back to the mountain, the view is of giant, black iron towers and factories curving against the white, naked mountain which was almost cut in half by the factory for the cement production. People breathe and walk in the dusty and foggy air. The buildings beside the road, some of them left by the Japanese but decaying and vacant, some built by low-cost and mass-production methods, are of mixed use, combining metal production industries or transportation tool repair industries with dwellings.

The riverside:

Past the railway space and toward the shore of Nei-Wei Lake, a flat plain with bushes and parallel one-story factories for the timber industries appears in place of the closed and dense street space to the side of Sho-Mountain. It is a large area enclosed within the railroad and the newly constructed infrastructure. Most of the northern part of the area is vacant. The road running through the bushes is about ten feet wide and leads to a group of mass-produced housing and a series of temporary illegal factory structures. These housing units are the only cluster residential buildings near the lake. The people living in the houses all use their living rooms on the first floor as small factories for mechanical production or plastic production processing (Fig. 23a). It is easy to get lost in this land because of the bushes and the absence of any indications on the road. No one enters the land except the people who live or work there. At the southern end of the land are huge

Fig.23a Home factories near the Nei-Wei Lake

Fig.23b Home factories on riverside

medium-scale timber production factories. The factories use the lake for processing the timber. They take up almost half of the land.

The land by the river is occupied by home factories and small-scale industries including mechanical repair, metal production processing, and electroplating factories. Mixed-use, heavy-polluting illegal factories with residential units are very common in this area. The factories are built beside the river and regularly dump sewage into it. The people living on the riverbank use the water for washing their clothes. The interesting thing is that the people are still concerned about their quality of living, as can be seen by the planting and landscaping most people do on the small piece of land in front of their houses. They clean their streets carefully. They have no choice but to settle in this area because of the cheap housing (Fig.23b).

Ming-Zu Corridor:

On the Ming-Zu Corridor, the atmosphere seems to be even more hectic. The Ming-Zu Corridor is not only a main access to the expressway from the city center, but is also directly connected to the central city core. Small transportation tool repair shops constitute the main industry supporting the commercial district's expansion in this area. Most of the mechanical repair industries settle in the minor streets of the corridor. It becomes a daily shopping district for the neighborhoods surrounding this area. The air pollution caused by the traffic and the transportation tool repair stores degrades the quality of shopping areas (Fig.24a). There are serious traffic jams in the rush hour on the corridor (Fig.24b).

Fig.24a Ming-Zu Corridor (transportation tool repair industry)

Fig.24b Ming-Zu Corridor (Shopping district)

3.2 INDUSTRIES

Although there are different service markets for these industries, most of the industrial production in this site mainly focuses on the local market. There are some international export-oriented industries centralized on the east side of the railway, such as the garment and accessories, plastic, and textile industries.[1] This is due to the fact that the area on the west side of the railway was developed before the area on the east side, which began to be developed in the period when the city started to concentrate on industrial production for exportation (Fig.25). Another reason is that the Ming-Zu Corridor and the Joe-Ju Fourth Road are two major accesses connecting directly to the expressway, the city core, the airport, and the harbor (Fig.25). Analyzing the industrial demand and the specific problems of each industry in order to determine the location of the industries and plan the land use of the area can satisfy both economic and living demands in the context of urban and industrial development.

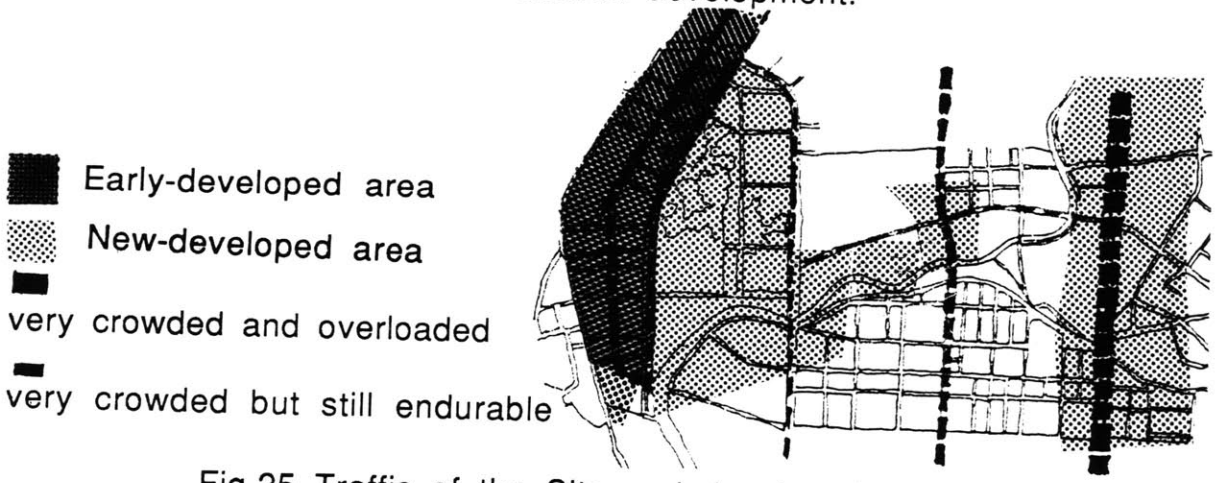


Fig.25 Traffic of the Site and developed stages

[1] Evaluation of Industrial Development & Location in Koahsiung, Public Construction Department of Koahsiung Municipality,1987.

3.2.1 HEAVY-POLLUTING INDUSTRIES

The cement industry:

The cement industry is an import-oriented industry. Sho Mountain is the main raw material resource for the industry. Access to raw materials is the main criterion for the location.

Pollution: Air pollution from the digging of cement from the mountain, visual pollution from the erosion of the mountain, water pollution and vibrations in the processing of cement.

Comment: Since the transformation of the industrial structure in Taiwan, the cement industry is no longer the basic industry supporting the primary production for the import market. It is not economical to locate the industry close to the central urban area for the sole reason of easy accessibility to raw material. Furthermore, the pollution caused by the industry has seriously degraded the urban environment. Moving the industry out of the city or transferring production to other countries is a solution.

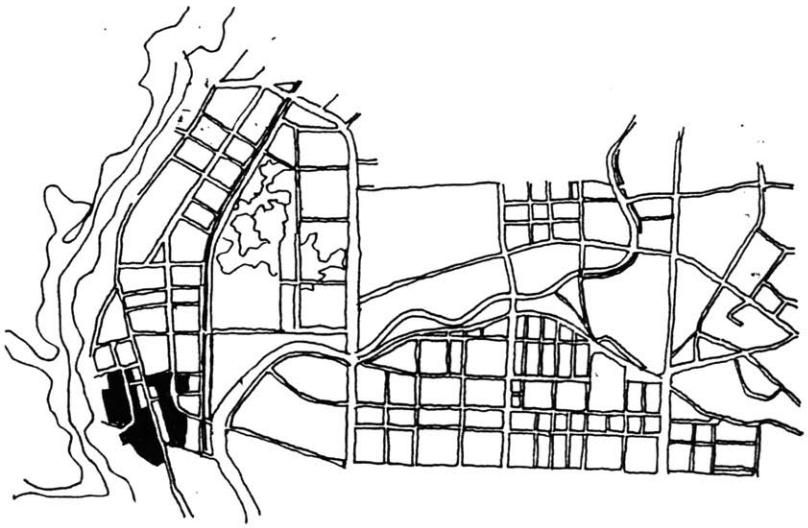


Fig.26 Location of cement industry

The chemical industry & the metallurgy industry:

These industries are centralized on the riverside and are mixed with residences. Most of them are illegal and without pollution-controlling facilities or sewage systems for polluted water.

Pollution: Water pollution

Comment: Most of these industries are small-scale and cannot afford facilities for handling the pollution. The determination of the location is due to the loosening of land-use regulation enforcement in the area. Industries locating here can avoid social and enviornmental responsibilities; pollution treatment is the greatest cost for the industry.

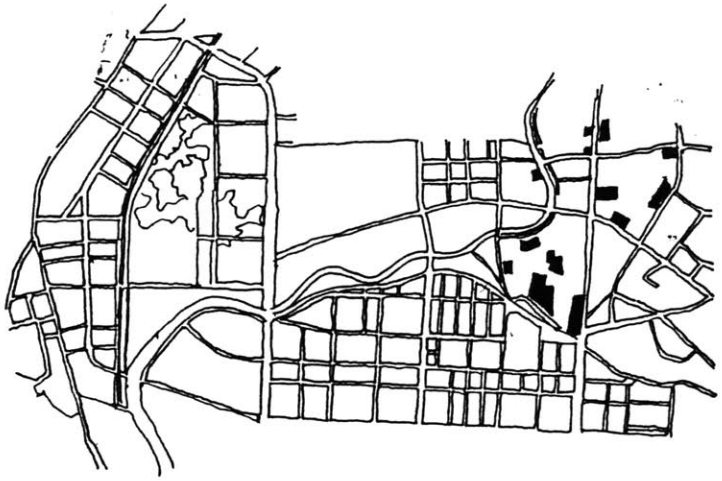


Fig.27 Locations of chemical and metallurgy industries

The metal production industry:

These factories are concentrated on the land beside the Chung-Hwa Second Road. The main concern in choosing this location is transportation. Now the Women and Children's Hospital of Koahsiung is adjacent to these industries.

Pollution: Air pollution, water pollution, and glare from factory light and welding equipment.

Comment:

The small-scale heavy-polluting industries need to be forcefully brought together and offered pollution-controlling facilities. The special locations for these industries should restrict their expansion.

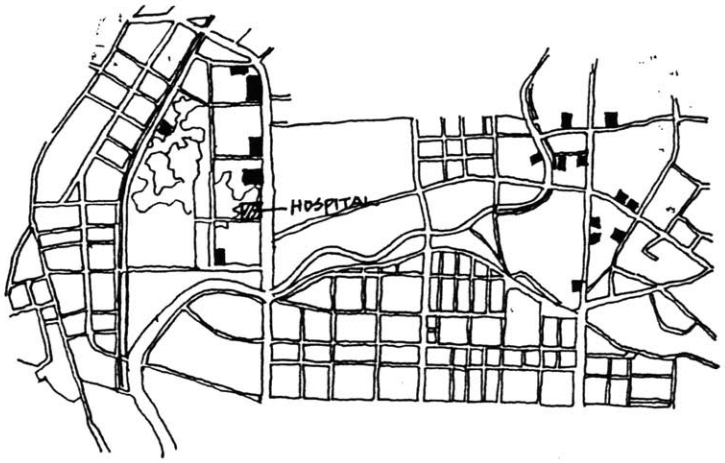


Fig.28 Locations of the metal production industry

3.2.2 LOW-POLLUTING INDUSTRIES

Timber and non-metal furniture production:

These industries need large spaces for factories, storage and workers. Transportation for production and proximity to raw materials is also a main concern for the location. The industries are concentrated on the flat plain beside the lake and Da-Shuan Road for the availability of land and the ease of transportation. The average factories' area is 1.39 ha. Half of the production of the industries in this area is for export, half is for the local market.

Pollution: Air pollution (odor-producing), vibration, and water pollution

Comment: The furniture-making industry is a conventional industry in Taiwan. Although it has entered the international market, the technology for the production is still labor-oriented and has not been upgraded. After the industries have been upgraded, the demand for the location will change. The industrial pollution will be controlled more efficiently.

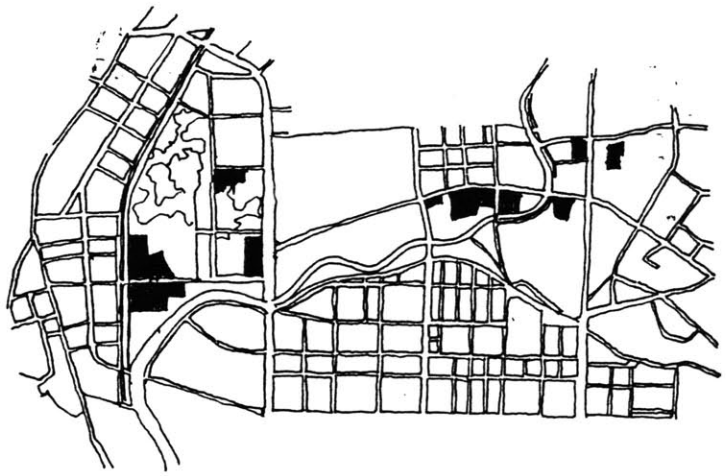


Fig.29 Locations of timber and non-metal furniture production industry

Garment industry:

The garment factories in this area are medium-scale. The market for this industry is in export. It is the main industry which distributes production activity to family factories in the area. The location is determined by the transportation facilities, which have to be close to the harbor and airport.

Pollution:

The industry in this area does not have a pollution record. It is the industry which has best controlled its production process.

Comment:

The demands of the garment industry are much like the furniture-making industry, and both industries need large spaces for factories. They tend to break the continuity of urban space. Keeping the industries in a specific area in order to meet the dual demands of size and location will greatly affect the transition of sites in the future because of the large volume of centers of industrial production.

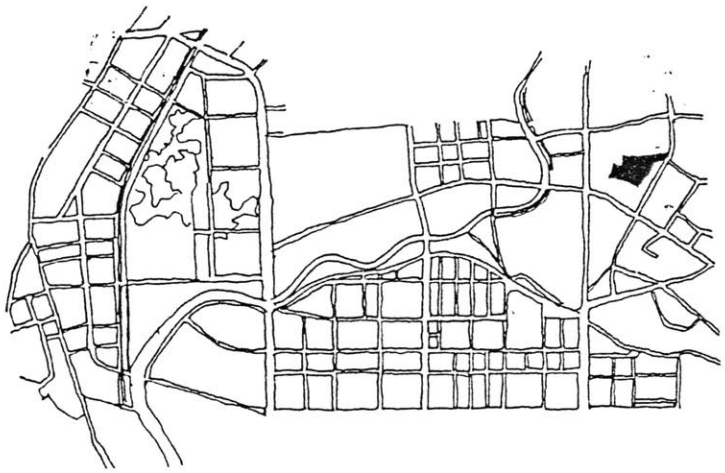


Fig.30 Locations of garment industry

3.2.3 NON-POLLUTING INDUSTRY[1]

Mechanical repair industry:

This industry mainly services the local market. Most of the workshops are small-scale and stay in the residential and commercial areas, but they can also be found on the minor streets leading to the freeway. They mainly exist in the form of home factories.

Pollution: Light pollution, noise pollution.

Comment: This type of industry mainly stays in the residential areas. Some characteristics of this industry are its tiny scale for family factories and its widespread presence in the area. The family needs only a steel cart to start the production process. This type of industry usually forms a neighborhood of home factories in the low-cost mass-production housing. This type of industry is common in Gu-Sheng Chu (the area beside the Sho Mountain) and beside the Nai-Wei Lake.

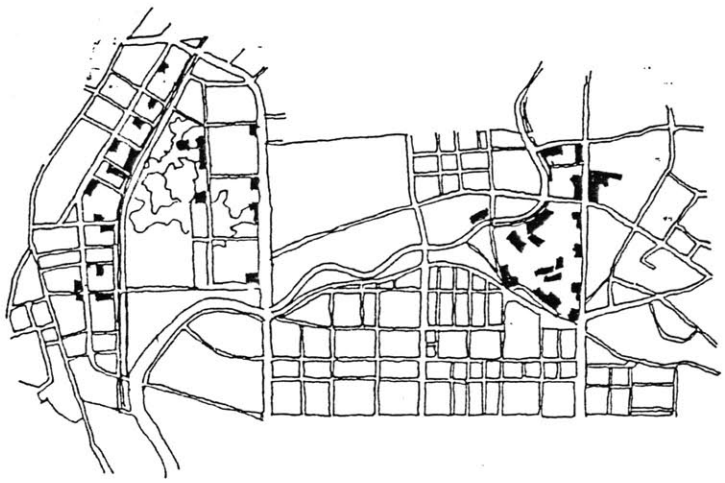


Fig.31 Locations of mechancal repair industry

[1] This term falls within governmental regulations, but actually the industries produce pollution in the environment to a very low degree, mainly as visual or waste gas pollution.

The transportation tool repair industry:

This is a local service industry located in the areas near the sides of freeways. The first problem of the industry is the misuse of the land; 60% of the industries are located in the residential areas, 25% in the commercial areas. The other problem is that the existing average area (1196 square feet) for the industries is not enough for use. Because the buildings have been converted from other uses, the minimum area requirements of the Regulation of Motor Repair Industries are hard to satisfy.

Pollution: Air pollution, noise, light, and vibration

Comment: The commercial use in the Land Use Regulation is stated by exclusive definition. The use by the transportation tool repair industry is not stated in the regulations, but it is essentially a commercial industry. Noise and air pollution are the main conflict with the mixed-use functions. The large-scale transportation tool repair industry (5.5 ha) has a different demand than the small-scale ones. The former needs large spaces to build factories, and the latter takes the shape of linear commercial activity.

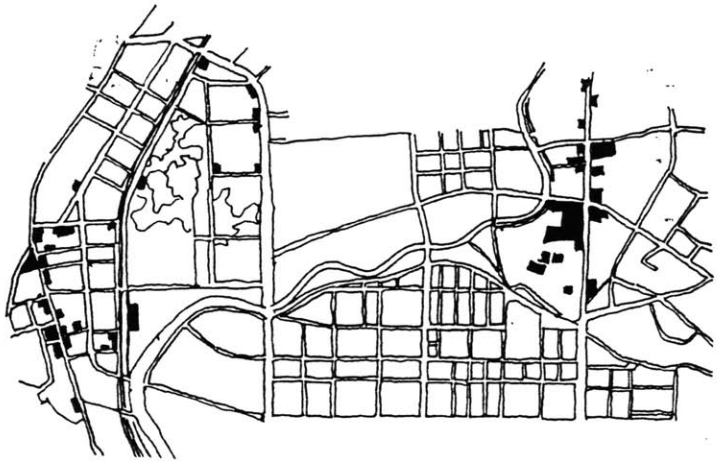


Fig.32 Locations of the transportation tool repair industry

3.3 THE PHYSICAL FORM AS DETERMINANT OF THE RELATIONSHIP BETWEEN INDUSTRIES AND HUMAN FRONTIER

The typological study of different industries provides a profile of the interrelationships among different types of industries and people, and the environment. I will define these relationships on different scales and different levels. In the building scale, I chose the home-factory complex for studying, since it is the closest relationship between industry and people.

3.3.1 MIXED-USE BUILDING

There are only two ways of dividing the industrial production space and people's working space in the home factories: vertically and horizontally . The process of forming the spatial division is different for both types. The former is divided of the production function space and living function within a residential entity (Fig.33a). The latter is originally two entities, home and factory, connected by an addition such as a service entrance or passage. The entity has two separate structures (Fig.33b). We can discover an appropriate pattern for combining dwelling and working by looking at the two methods of division, which physically describe the story of home factories through the grammar of material, additions, and the order of space and form.

A. Internal spatial relationship:

Mobility is an important demand on spatial use in the complex entity of a home. The mass-produced housing in the private sectors is the main

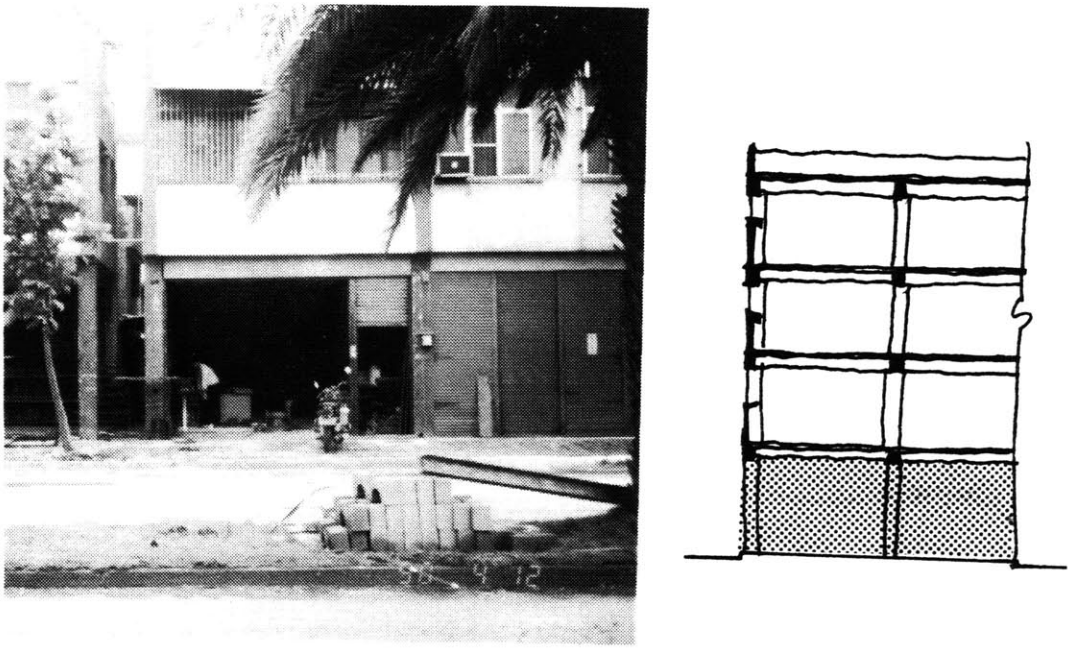


Fig.33a Vertically divided home factory

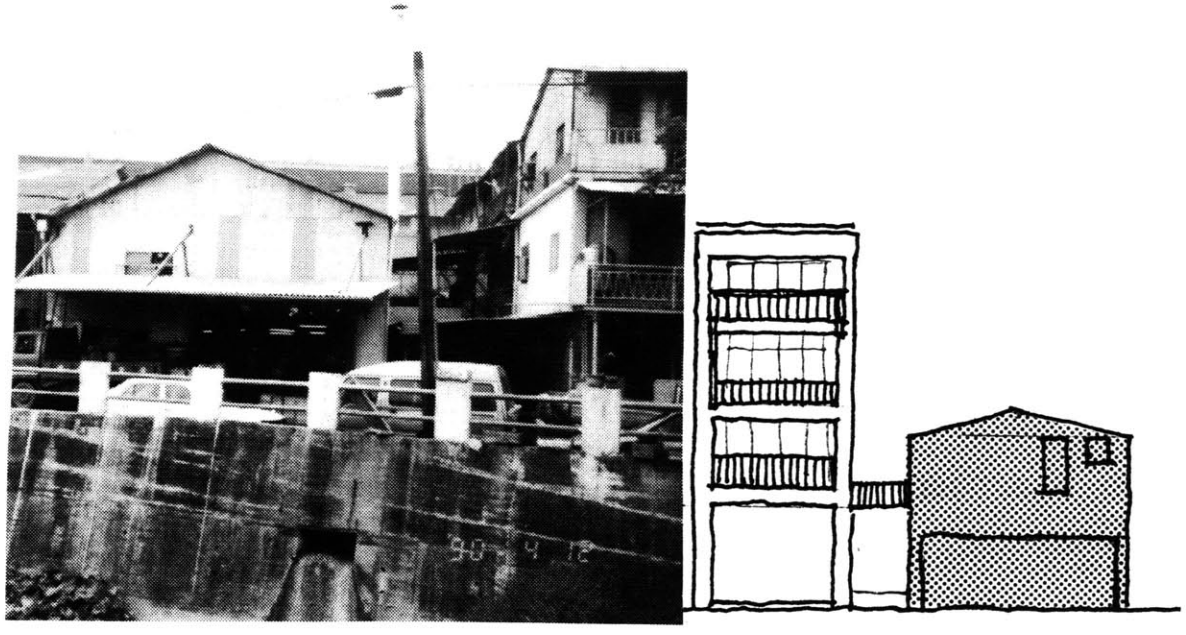
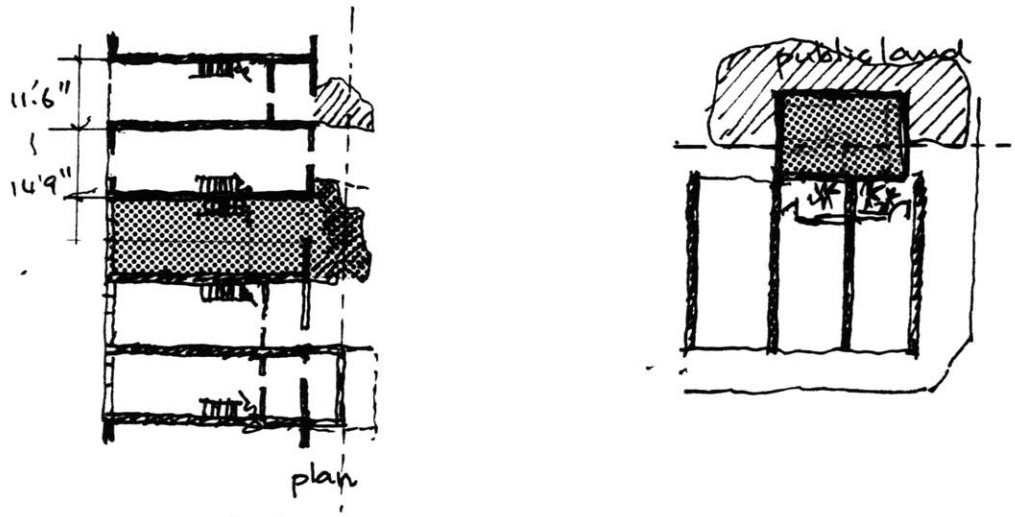


Fig.33b Horizontally divided home factory

location for home factories. In the case of vertical division, it is usually one module in the range of 11'6" to 14' 9" for both living and industrial production activities (Fig.34a). The form of the working space has the same layout as that of the living space. It is an economical fit to the limited environment. In the case of horizontal division, the factory part is usually an addition to one of the mass-produced housing units, or else is a separate structure with a construction under the same mass-produced housing system (Fig.34b).[1] The form and area for production space is much more independent from the living space than in the vertically divided structures. Providing different modules for further subdividing the housing could increase the flexibility of the special functions of home factories .



a. vertical b. Horizontal

Fig.34 Different layout of two divisions

[1] The same mass-production housing system means under the same material and construction method, the same economic estimation to the determination of module and spatial arrangement, and even the same prefabrication system.

We can find a regulation for the functional division in the mixed-use entity. The method of dividing space depends on physical restriction of the module to combine two different functional spaces: working and living. If the building is a whole entity with one construction system, then the most economical way is to make division of the two function spaces vertically rather than horizontally, the reason being that a module of 11' to 15' is not appropriate for dividing into two spaces. If the buildings are built by the combination of two entities, it naturally becomes horizontally divided. This is a further factor determining the division into different functions.

B. External spatial relationships:

The type of industrial production determines the hierarchy of the internal space with respect to the public. The space can also be used for two different functions. One is a pure working space without commercial activities, such as the typical home-based processing working space. The other is a production space which also has a commercial use, such as the mechanical repair and transportation tool repair industries, which have a different relationship between the entity and the street as well as a different internal organizing order.

From observation, the facade on the street does not reveal the relationship of the inner activities to the street, because the two side walls make the facade the only way to get light and ventilation. In this way, a transition space can be placed in between the working space and the street. The arcade facing the street, although usually occupied by the expansion of factories, can offer a transition margin for the

relationship with the street if it can function in the urban space as a passage (Figs.35a,b).[1]

C. Spatial form:

In the vertical model, the strong spatial frame which is under the restrictions of structure of mass-production housing controls the modification of the entities' form. The spatial form follows the two side walls and is restrictive but regulative. By contrast, on one level afforded in the horizontal model is much freer in forming its own inner space. (Figs.36a,b).

D. Addition:

The different compositions of each kind of home factory also depend on the growth pattern of the entity. Most of the additions in the mixed-use case are for the expansion of factories.[2] In the vertically divided form, when the working space on the ground level extends to the edge of the territory, it usually goes up to the top of the building and connects to the original factory with a simple lift. The living space is then vertically enclosed by the working space. It indicates the hierarchy in the whole entity: street. . . major working space. . . living space. . . minor working space. The lift element expresses the relationship of the two working spaces (Figs.37a,b).

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[1] There is a regulation in the building code about the holding of arcade space when the street in front of the building is over 23 feet.

[2] By personal observation.

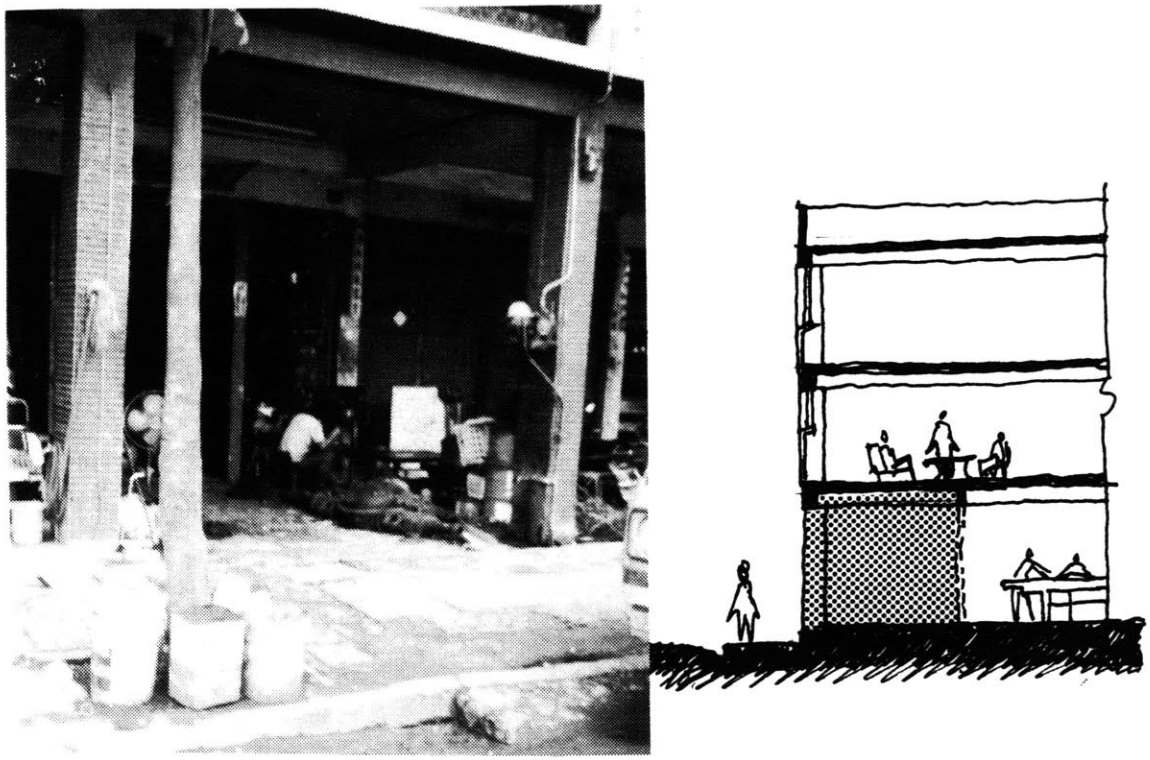

Fig.35a.b. Home factory and the urban space

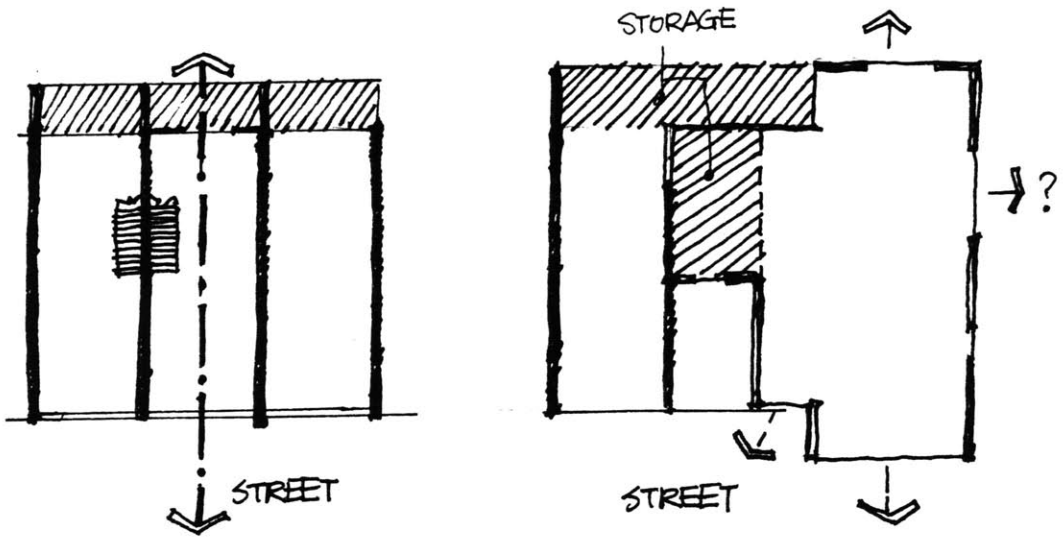

Fig.36 Form of the home factory

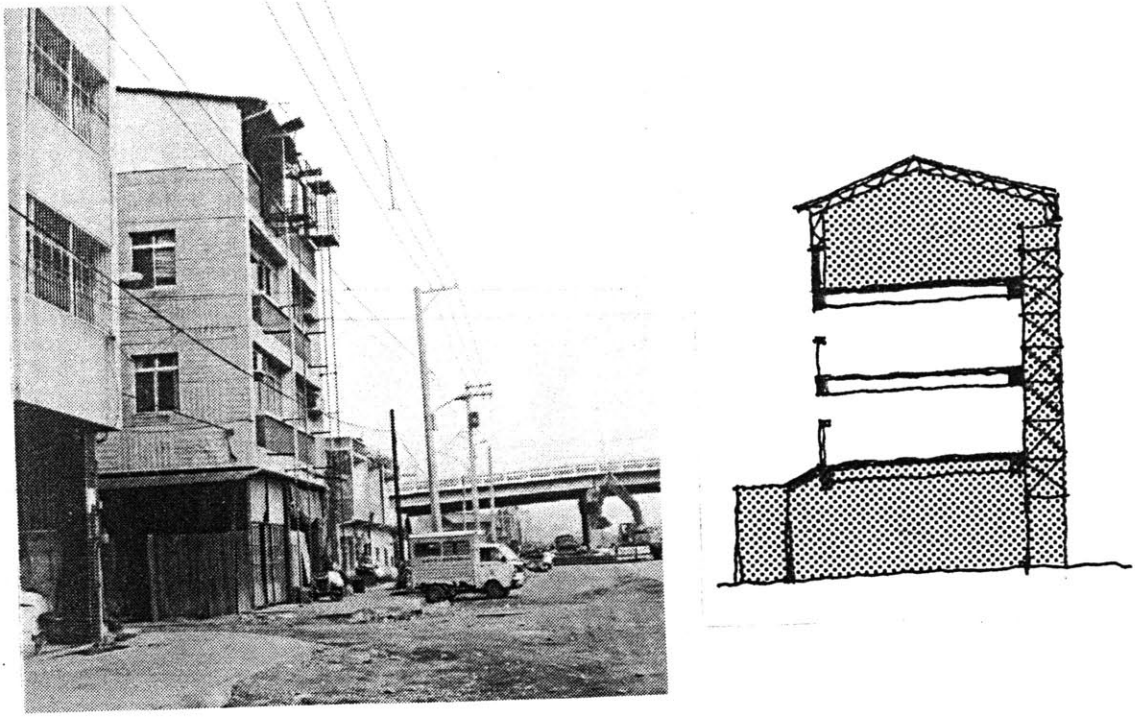

Fig.37a.b Vertical Division Addition

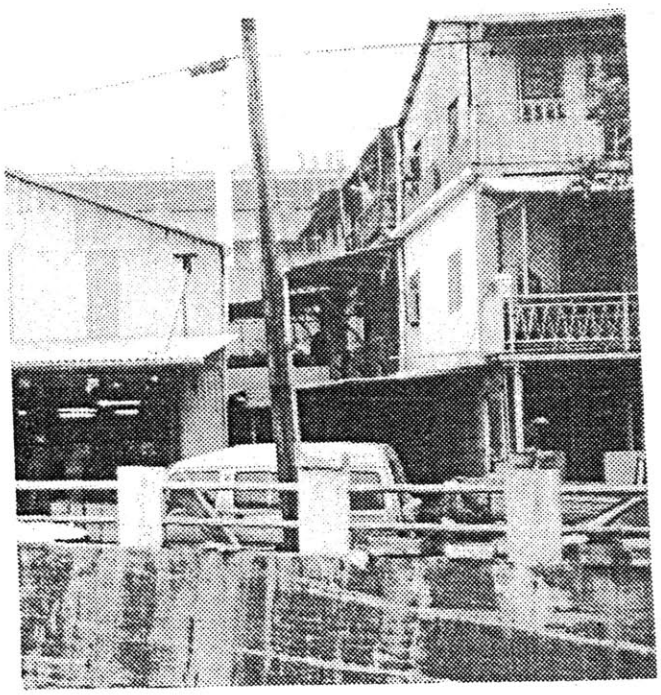

Fig. 38 . Horizontal Division Addition

The addition of the horizontal division sometimes becomes the transition space between living and working areas. The service space fills in the addition and keeps the two functions separate (Fig.38).

3.3.2 COMMUNITIES

Since economic factors increase the mix of industrial, commercial and residential functions in the area, the boundries between different function areas are hard to determine clearly. The street encourages the transportation repair tool industries to form a linear commercial area. Convenient transportation brought in the spontaneous formation of industrial factories and cheap mass-production housing by formal or informal production processes. The home factories appeared within the housing units and further fertilized the commercial activity of the area. The urban fabric reflects the organic growth of these activities. This relationship is so coherent with the occurrence of these functions that they should be based on the economic relationship between industry and the city. Then it would be possible to keep the spatial quality while avoiding the disconnection of the interlocking relationships of the activities in the area.

According to the new arrangement for the industries, a new order and relationship between the light-polluting industrial communities, non-polluting industrial communities, commercial and industrial residential communities, home factory communities and purely residential communities will be created. If we set levels for the spatial relationship (which depends on the degree of impact of the

production to the people's living space) between these groups from the closest to the farthest, there are five levels, which are shown in Figure 39:

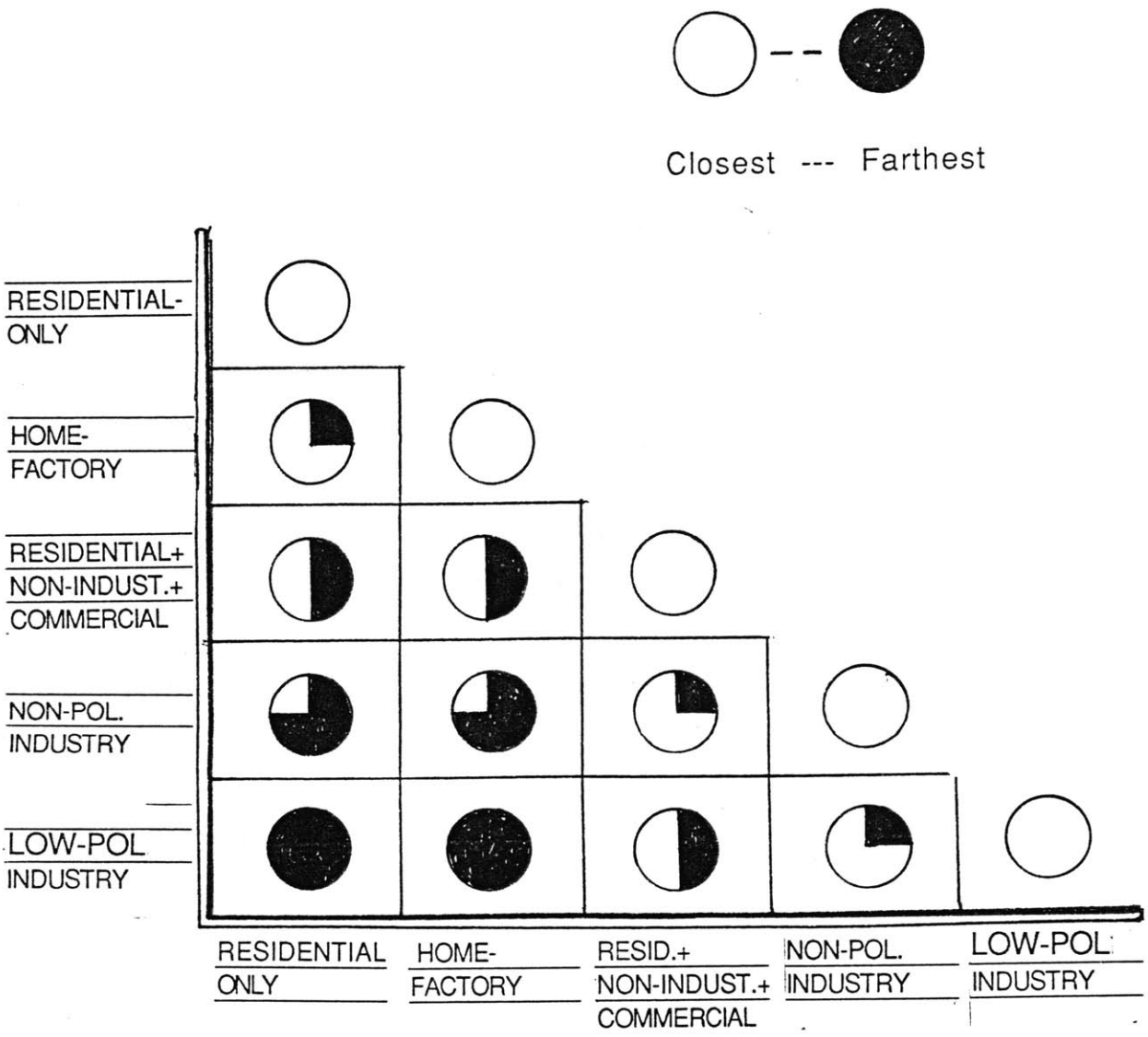

Fig.39 Propose Levels of Functional Relationship in Different Land Use

3.3.3 URBAN SPATIAL ANALYSIS

A. Urban block:

Different urban textures show different types of industrial development in this area. In the Sho Mountain area, the grid street system was developed in the period of Japanese rule. The standard size of the block is 240 by 363 square feet, or 250 by 453 square feet, or 240 by 543 square feet. The three roads which are parallel to each other form the main infrastructure of the area. The size of the street along the mountain is 40 feet wide. The width of the street in between the railway and the one along the mountain is 60 feet, and this street forms the main commercial district of the area. The street along the railway, which is newly developed, serves as a freeway connecting to the other cities. Except the site of the cement industry, the street pattern is not designed for industrial use.

In the area between the railway and the corridor, which was developed after the recovery from Japanese rule, the blocks are roughly divided and unregulated. The largest site reaches 33,330 by 1,663 square feet. The infrastructure adjacent to the site is about 100 feet wide. The planning idea of the block size and street pattern is to utilize the land for large-scale industrial sites. The distribution of different types of the industry in the area is related to the urban texture as dictated by the area's infrastructure and the demands of spatial volume for the industries.

B. Urban spatial distribution:

The distribution of activities should match the spatial structure of the city, just as in a small district. This area includes both the static and mobile character of space. The elements that form this character are the infrastructure and natural elements--mountain, lake and river--according to their spatial relationship with the city and the character of their physical forms. The Ming-Zu Corridor presents a highly mobile image in this area because it is the main connection of this linear city to the expressway. Furthermore, it is the very first transition space that the large traffic volume of the city must pass through in order to access the expressway. The area beside the Sho Mountain and the land of Nei-Wai Lake projects a static image, because the vertical element of the mountain forms a visual image of the edge of the city (Fig.40a). The space also visually follows the mountain and extends to Zuo-Ying Chu[1] and might be a corridor to connect the commercial activities of the central urban area to Zuo-Ying Chu. Between the lake and the Ming-Zu Corridor is a flat plain with a winding river going through it, which forms a transition space between the mountain and the corridor. The space follows the curve of the river and relieves the tense pace of the freeway (Fig.40b). The spatial structure of the area offers an transition from a natural to a human dimension, from the historical to the new speedy urban context. The redistribution of the urban activities should be set up with reference to and function with this spatial structure.

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[1] See Chapter 2.1.2 Gu-Sheng Chu industrial area.

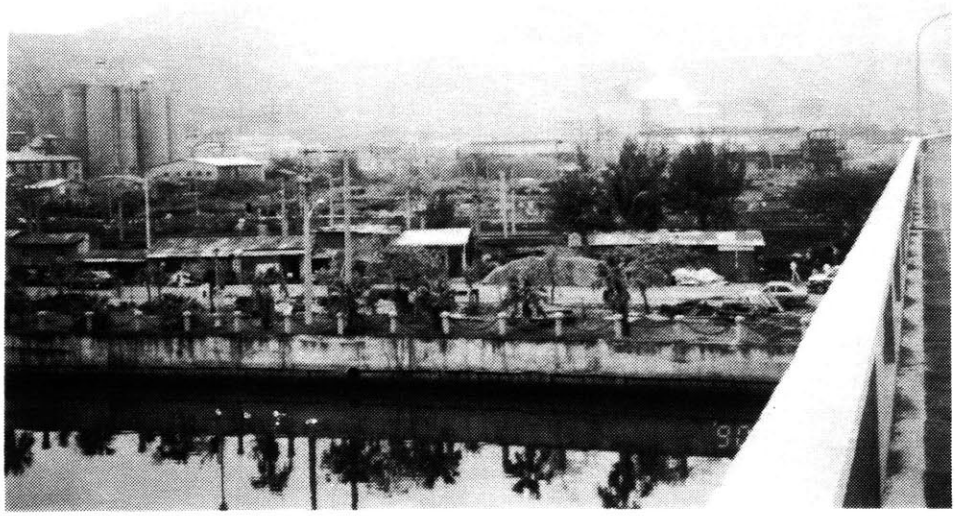

Fig.40a View of mountain edge

Fig.40b View of winding river

CHAPTER IV

ASPECTS OF SPATIAL MANAGEMENT

In this chapter, I propose principles for redeveloping a specific site, which has small-scale industries on the edge of the central urban area, as a general strategy for spatial management. Exploring the value of land in advance through redevelopment is the main physical solution to the problems of the growth of the central urban area. The suggested methodology for urban development in this case study can be used as a reference for developing other areas within the urban context.

4.1 RECONFIGURATION OF INDUSTRIAL DEVELOPMENT

In order to understand the conflict between industries and people one must see the local and small-scale industrial development within the larger structure of urban development. The industries are fine-grained but important organizing elements of the urban context. Conceptually, the fragmented small-scale industries need to be shaped into a whole through a thorough topological study of the industries and their manipulation. In the urban structure of Koahsiung, the industrial layers are visibly organized by the underlying economic dimension and the relative relationship of people inside and outside the inner industrial frontier. Location determines the cost of production, and productivity strongly affects the value of the industries for people. Distribution of the industries should balance this dimension in different stages of urban development. If the industrial frontier in the urban area can

continue to function while adjusting to changes in urban functions and people's lives, both economic and human value can be achieved in urban evolution.

Redefining the role of the small industries and the effective spatial pattern of productivity can help define a strategy for spatial management of industries.

The industries in this area are in all three of the following categories: non-polluting (42.8%), low-polluting (17.5%), and heavy-polluting (40.7%)[12] (See Table 5). The metal production industry owns the most factories in the area, followed by the metallurgy industry. Low-polluting industries are food processing, fabric & accessories, and non-metal furniture and timber production. Non-metal furniture and timber takes 39.9% of the all the factory area in the site. The water land in this area is what attracts the timber industries.[3]

According to the table, we can observe what types of industries exist in the area and in what state. We can use the table as a reference for the replanning of industrial development. Transportation tool repair (12.1%), metal production (25.2%), and mechanical repair (12.76%) are small-scale and widely distributed industries in the area. The

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[1] The categories are defined by the land use regulations of Koahsiung City.

[2] The percentage = no. of factories of the categories/ total no. of all factories in the area.

[3] Table 5 "Industries in the site." The indicator of distribution = average area of industry/ no. of the factories of the industry, which can be a reference for comparing the ways of distribution of different industries in the area. The value is not a real value and has to be observed with the average area of that kind of industry, then it can provide a profile of the distribution condition.

mechanical repair industry, which takes up the highest proportion of the total number of factories and the smallest average factory area, is the most store-like type. The non-metal & timber furniture industries are also widely distributed but need more space and labor for production.[1] The ability of the urban space to absorb those industries should be different. For the sake of both industrial productivity and the urban texture, those industries need to be categorized and rearranged. Categorizing the industrial types can provide a basis for replanning the area and redistributing the industries according to land function and the ability of the area to absorb the industries.

4.1.1 Recommendation 1. The heavy industries have to be moved out of certain areas according to the function of the area in the city.

The site should be saved for urban expansion because of its accessibility from the central urban area by three freeways. In the area beside Sho Mountain, the cement industry, which is the only large scale industry in the study site, must be removed to prevent the decaying of the area and give the natural environment--the Sho Mountain--back to the people.

Cement production has been an import-oriented industry since the period of Japanese rule. Since Taiwan's industrial productivity structure is changing and being upgraded, this industry is now obsolete and can be eliminated from the urban industrial production system.

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[1] Table 5 Average factories area of non-metal furniture & timber production/ mechanic repair = 2.19/ 0.0013.

From an economic point of view, the industry should be relocated in order to convert the land for other uses. The reasoning is that the public and private sectors both have equal ownerships in the industry. The public sector has recently begun to change its way of running the business by issuing stocks to decrease the industry's deficit, and is in agreement with the private sector regarding the future uses of the land now being occupied by the cement industry. Under these conditions, the industries occupying this land will have no more reason to stay in such close proximity to the central urban area.

The process of relocation also needs to plan the resettling of the small-scale heavy industries, because the number of heavy-industry factories is 40.66% of the total factories in the area.[1] Moving all the heavy-polluting factories will effect a big change in the land use of the area and the people depending on the industries. Setting different time frames for the relocation of various industries and planning for new sites for resettling those industries can help to decrease the social cost of the move. For instance, of all the industries in the area, the metal production industry accounts for 25.2% (73 factories), the largest percentage of industries located within the residential and commercial area. The time frame for the relocation of all the metal industry factories to an indicated site should be longer than that of the other industries. The authorities could subsidize the industries or grant tax deductions in the start-up period, or help to build factories and upgrade the technology of production and facilities. The authorities

[1] Estimation from Table 6.

could also set the stage for transforming the land use through compensation or converting the land to commercial or residential use as a way of encouraging the owners of the factories.

4.1.2 Recommendation 2. Building industrial communities in industrial zoning areas to settle part of the low-polluting and non-polluting industries.[1]

The three types of light industry - food processing, garment and accessory-making, non-metal furniture and timber production - all need large spaces. The impact of the food processing industries on the environment involves the emission of odors in the air and the pollution of water resources. The timber production industry also needs a large water area to immerse the wood. All of these three need a large amount of labor to support their production. The workers do not necessarily live adjacent to the factories but they still have to have easy access to the factories.

The industrial communities can be categorized by the relationship between labor and the factories. One is a pure industrial community composed of factories, the other a community that is allowed to have some residential sites for laborers. The differences between the two determine the location of these industrial communities in the area. The former will depend on the means of transportation of materials, productions, and laborers. The latter then has to be located at an

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[1] The original idea is mentioned in Evaluation of Industrial development and Location of Koahsiung.

acceptable distance for the people living in the community in order to be near the public facilities and shopping areas. In other words, the choice of site should take into consideration the convenience of carrying out the daily activities of the workers in the community.

The government could also subsidize the removal of these industries and set up a better industrial environment to attract the industries to move to. The site could be funded by the government or private developers. The industrial community could utilize the sites for the factories by considering the production process beforehand. The industrial community could also keep these light industries in a chosen site to prevent them from spreading to all the valuable natural resources in the area.

4.1.3 Recommendation 3: Updating the residential- and commercial-use zoning regulations.

The zoning code should have more flexibility for inserting the home factories of non-polluting industries into residential or commercial areas. Since the production is a subsidiary activity of the families, the families still have to be in a residential area and share the public services with other residents.[1] However, the actual pollution that the home factories produce in their environment is visual and sound pollution. The families used to illegally build additions in their backyards and on public land as storage space, or block the arcade to

[1] See Chapter 2, "Home factory."

extend their working space when they were facing the main street. There are two explanations for this: firstly, the building code cannot effectively regulate their activities; and secondly, the typical residential unit becomes too small when space is also used for production activities. The other case is that of industrial use in the commercial area. The transportation tool repair industry and the mechanical repair industry support most of the commercial activities in this area. The industries produce waste gas and noise along the commercial district.

Demands on the quality of the living environment should effectively reflect on land use regulations at an executive level. It is essential to further categorize the various activities in detail in the residential and commercial areas and to adjust the building codes to match those different categories. At present, there is only one category of residential land use in Koahsiung's regulations. In Taipei, the regulations have been developed to cover four categories in order to fit the complicated demands of an urban residential environment in transition. The goals of categorizing residential use are listed as follows:[1]

The first level residential area:

This level maintains the highest living quality, is designed for single family and multiple family residential use, keeps the lowest

[1] The 4th article, Land Use Zoning Regulation and Legend of Taipei Municipality.

population and building density, and prevents non-residential use in the residential area.

The second level residential area:

This level maintains an upper-to-middle quality of living, is designed for residential, daily retail or service business use, keeps a medium population and building density, and prevents industrial and medium-scale commercial use in this residential area.

The third level residential area:

This level maintains a middle quality of living, is designed for residential, daily retail or service business use, keeps a high population and building density, and prevents industrial and medium-scale commercial use in this residential area.

The fourth level residential area:

This level maintains a basic quality of living, is designed for residential, daily retail and low-polluting industrial use, and prevents large-scale industrial and commercial use in this residential area.

Each level of residential area has different a building code and density limitation.

In the fourth level category, there are additional regulations for industrial use in the residential area. For example, only the lightest-polluting industries (bakeries, candy production, secondary paper production, handcrafts, garment production, tea processing) can be

located in this area, with accompanying regulations as to power use in the industry. The area must be no more than 1089 square feet, and the opening should be more than one seventh of the area of the factories.

The regulation for commercial use has four levels, and only the lightest-polluting industries (the same industries permitted in the fourth-level residential area) are allowed in all four categories. The low-polluting industries (printing, paper processing, high-tech mechanical production, transportation tool repair, etc.) must be further approved by the government.

The regulations about the residential and commercial use of Taipei are more flexible than Koahsiung. Since industry still plays a significant role in the Koahsiung's economic structure, the land use regulations need to follow the distribution of the industries to be more acceptable and to function more efficiently and realistically .

4.2 MANAGING LAND RESOURCES

The land management in this area is inefficient because the planning of the infrastructure is not matched to the traditional urban growth patterns of Taiwan (which form a linear and leap-frogging pattern) and the natural element--the river. The street pattern does not fit with the river crossing the area, and is further blocked by the connections between the linear spaces which have been developed. We can observe the different stages of planning by comparing the street patterns of the area with the central city core, which is to the south of the Gen-Eai

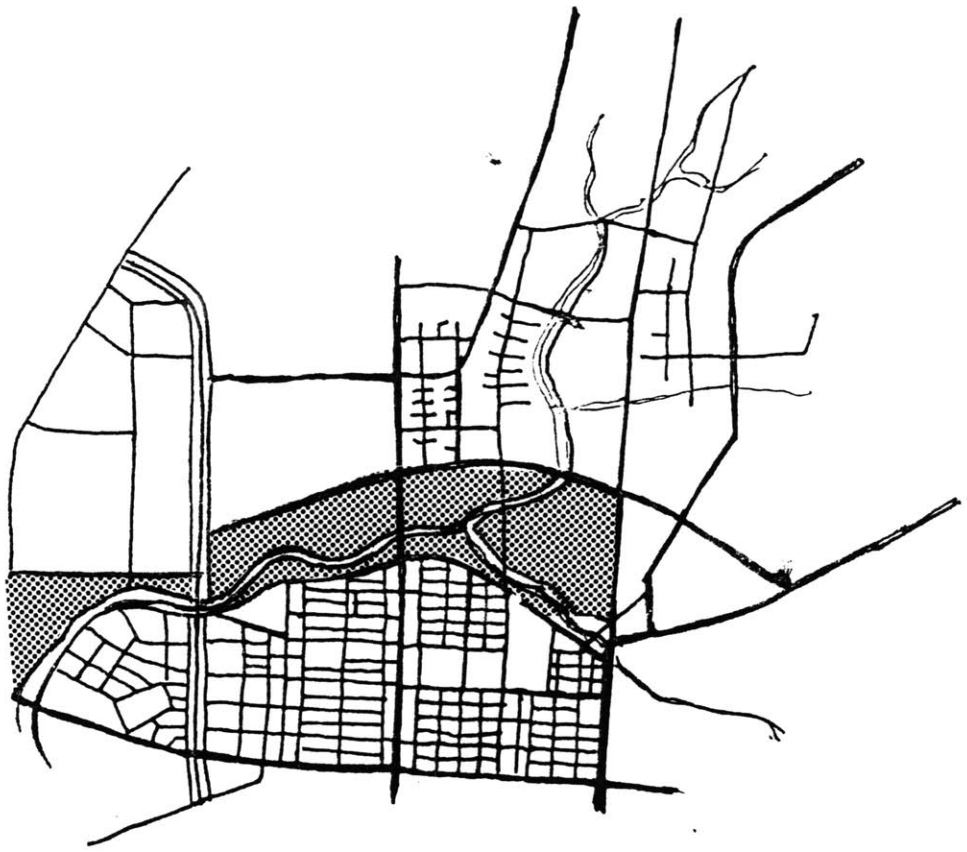

Fig. 41 Different Street Pattern of Old and New Developed Area

River. The old street pattern in the central core followed the curve of the river achieving a full, spatial management and preventing defiled urban space, even though city planning in the period of Japanese rule also pursued an efficient urban spatial structure.[1] The grid street pattern effectively shaped the character of the urban growth, so that the land in the city core is much more coherent than in the area of study (Fig.41).

The land use and urban development of the area are now in a fragmented state. The land vacancy rate of the area is 12.9%.[2] Another aspect is that public construction can not go beyond private development, and the private developer will not develop these marginal lands until the land value goes up. The area just follows the land use automatically. The other obvious factor is the growth of unplanned and spontaneous small-scale industries in the urban area causing a disconnection between the linear urban districts. Linear commercial spaces along the main streets cannot grow to a plain in the urban fabric when the industries (not the shop-store type industries) are stuck in between them. This shows the obvious decaying of the land in the area between one freeway and another. Squatter settlements and illegal factories gathered around those "in-between" areas along the river continue to pollute the city. The private power has expanded to the public or vacant private lands with weak restrictions.

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[1] See Chapter 1.3.

[2] Estimation from Table 6.

4.2.1 Recommendation 1: Encouraging large-scale development in this area.

Large-scale development could integrate the fragmented distribution of the industries in the urban area and transform the growth pattern from the gathering of points or linear space to a plainer growth pattern.

Transferring the linear organizing pattern to a plainer organizing pattern has several advantages for urban development. Firstly, it can prevent the physically fragmented urban growth. Secondly, it can save time and energy in the urban negotiation process. Land acquisition usually takes a long period of time because of the administrative work between the public and private sectors and the negotiation process with the land owners. Time increases the cost of the development. Thirdly, the land acquisition process can help the government to acquire a larger amount of public land for public housing or open space and to solve part of the problem in the shortage of public land.

The scale of the project can be measured by blocks or natural elements so that the development can cover the irregular layout shaped by the streets and natural elements.

The large-scale development in this area can be applied according to the concept of industrial community mentioned in 4.2. It is suggested that the industrial communities collect the light industries in regulated sites for the management of the environment. In the

developed site, the developer can satisfy the demands of different industries in the quantity of factory space or pollution-proof facilities.

4.2.2 Recommendation 2: Strengthening the construction of public land to increase the land value.

Although development can raise the land price of the area, it must remain stable when the land price is not far from the land value. The changing of land values reflects the supply and demand of the land market. How to raise the land value to attract developers and supply the demand of the central urban area is the major issue for the land in this area. Keeping public construction to public lands can be a powerful implementation tool to reach the desired goals under the strong demands of the land market.

Exploring public land as a resource for development can help to start private investment. In the area of study, the land for public use is 19.8% of the total land area. In all of the public land, the land for infrastructure takes 22.6%, and the water land takes 58.52%[1], so that utilizing the waterland becomes a point of initiative for development in the area. Almost all of the waterlands are unavailable for public use because they have been polluted or used by the factories for immersing timber. The riverbank on the upstream section of the Gen-Aei River is

[1] Estimation from the_Table 6 Land use investigation and analysis of Koahsiung industrial area.

either encroached upon by the factories and squatter settlements[1] or is used for storage space.

Managing the vacant land in the city is especially energy-consuming because the evolution of powers existing in the urban settlements has to reach a state of balance by changing the physical environment. In Transformation of the Site, N. J. Habraken discusses the interaction between "public space" and "private space":

> ..... When we take a map of a residential neighborhood and we color black the private territories and keep white what is public space, we can almost measure the relative strength of the public power. Mapped in this way, Lincoln, Massachusetts, which is an affluent suburb of Boston, comes out not much different from a squatter area in, say, Lima, Peru. In both cases, there is little white on our map. In both cases the private powers have relative strength and tend to minimize the public space that they share and control. In both cases also, the power in control of the public space is formed by the aggregate of the inhabitant powers.

The same rule can be applied in this case. The way to preserve the land is to run the function of the land or to put an authority on the land with physical form.

The way to utilize the waterland for exploring urban land value is to clean the river and manage the riverbank at the same time. The road beside the riverbank was the first construction with which the public sectors tried to utilize the waterland, but without further managing the land beside the road which borders the river. This land became the

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[1] By personal observation.

ideal place for illegal factories. The way to manage the land on the riverbank is to develop the infrastructure and the land beside the infrastructure together, thereby controlling the use of the river by the land tenant and maintaining the quality of the waterland. According to this concept, the physical form on the land beside the river depends on the value of the land and the zoning code. If the land has not been developed it can exist as a state of open space, such as a park or plaza.

4.3 CONCLUSION: A HUMAN VISION FOR THE INDUSTRIAL BELT

4.3.1 Philosophy

Thinking about the city of tomorrow is much like making drawings on a transparency atop the already existing transparencies of others. Every idea, element or dimension affects the urban context of the past, and our images for the future form a single page which project a new drawing on top. There is a certain chronological order to this, but sometimes the sequence is confused. In any event, if we are doing the drawing carefully, we cannot but focus on the past and the future at the same time.

Looking back to the past of Koahsiung city, we will see it go from a sub-city in the colonial system of Japanese Capitalism, to a city seeking equitable economic growth after recovery. But the problem has become clear: we must observe problems socio-economically and physically. The imbalance of human and natural ecologies has given evidence that the environment has come to pay the social cost of

economic growth. Disconnection between the different systems led to failure of organization. Pursuing an equitable, efficient, and cultural environment within an ecosystem balanced between humans and nature is the goal of Koahsiung for the future.

A balanced ecosystem should be able to adjust the conflict between different systems in the urban context through full communication and adaptation to changes. Urban structure provides a shelter for the human working system within which people can associate with each other's living patterns. The urban context is also the result of the evolutionary process and a collage of different factors from different entities. For instance, the relationship between the urban economic production system and the human living environment in the urban context are mutually productive and destructive. When the relationship reaches the balancing point, all the entities in the whole ecosystem can benefit. The same applies to the relationship between the human environment and natural environment. The balancing point can be reached by consistent communication and adaptation to upgrade the system. Providing information from different sources to the decision-making individuals or institutions in the city is a starting point for communication.

4.3.2 Vision: The Symbiotic City

CRITERIA

--Creating a completely urban living environment for various demands.

--Relieving the urban residential pressure of Koahsiung.

--Forming a natural living environment in a system of green space.

--Creating human value-oriented living environments by the identification of natural and human resources.

IMAGE

Healthy, cultural, pure and green, vernacular

MAJOR ORGANIZING ELEMENTS

residential communities:	residential-only communities, home factory communities, health care centers, parks, playgrounds, local shopping streets.
Institutes and cultural services:	museums, theaters.
Industrial community :	housing, medium and small industries, community parks and community centers.
Joint elements:	urban parks & plazas.

STREET PATTERN

Continuing the grid system of the city core, but with more consideration to the size of the street in order to meet the human scale. The street pattern near the river banks will follow the pattern of natural features. Elsewhere, street patterns will continue the grid system but be differentiated by the urban or community scale to make the land use intensive.

SPATIAL ARRANGEMENT

A. Residential pattern:

Different types of residential uses are offered with different regulations to feed the complicated urban demand. The residential units will be organized into communities, and the communities will be connected by open spaces and public service systems. The arrangement of the residential space will provide an order that enriches the spatial experience in daily urban living.

The types of residential land use include the production-residential area, the purely residential area, and the business-residential area. Proposing residential areas with non-polluting industrial production can not only socially and economically improve the families' living conditions but also promote the quality of different residential uses. Providing a community production program and opportunities for the people of low-income families to attend the family economic activities (which give the people a sense of their contribution to their families) are economical uses of the extra labor force of the society.

The home-factory residential site will be built up with housing units having more flexibility in the uses of interior and exterior space. The regulations regarding the distance between buildings and the area of openings in the building code are different from those of the residential-use-only site to prevent noise from impacting on living areas. They share the same community parks and public services, but will not be bothered by the production in the neighborhoods. The site is separated by streets or linear green spaces.

The buffer space between different zoning areas

According to the analysis of the functional relationship, we have five levels of relationship:

The first class:

The same function categories.

Suggested division: no division .

The second class :

Residential-only	-- Home factory residential use
Residential & non-polluting industry & commercial	-- Non-polluting industries
Non-polluting industries	-- Low-polluting industries
Suggested division:	**street, linear green space, division construction (noise-proof, etc.)**

The third class:

Residential-only	-- Residential & non-polluting industry & commercial
Home-factory residential use	-- Residential & non-polluting industry & commercial
Residential & non-polluting industry & commercial	-- Low-polluting industries
Suggested division:	**Park, freeway, parking lot, railway**

The fourth class:

Residential only	-- Non-polluting industry
Home factory	-- Non-Polluting industry
Suggested division:	**Parking lot, plaza, city parks**

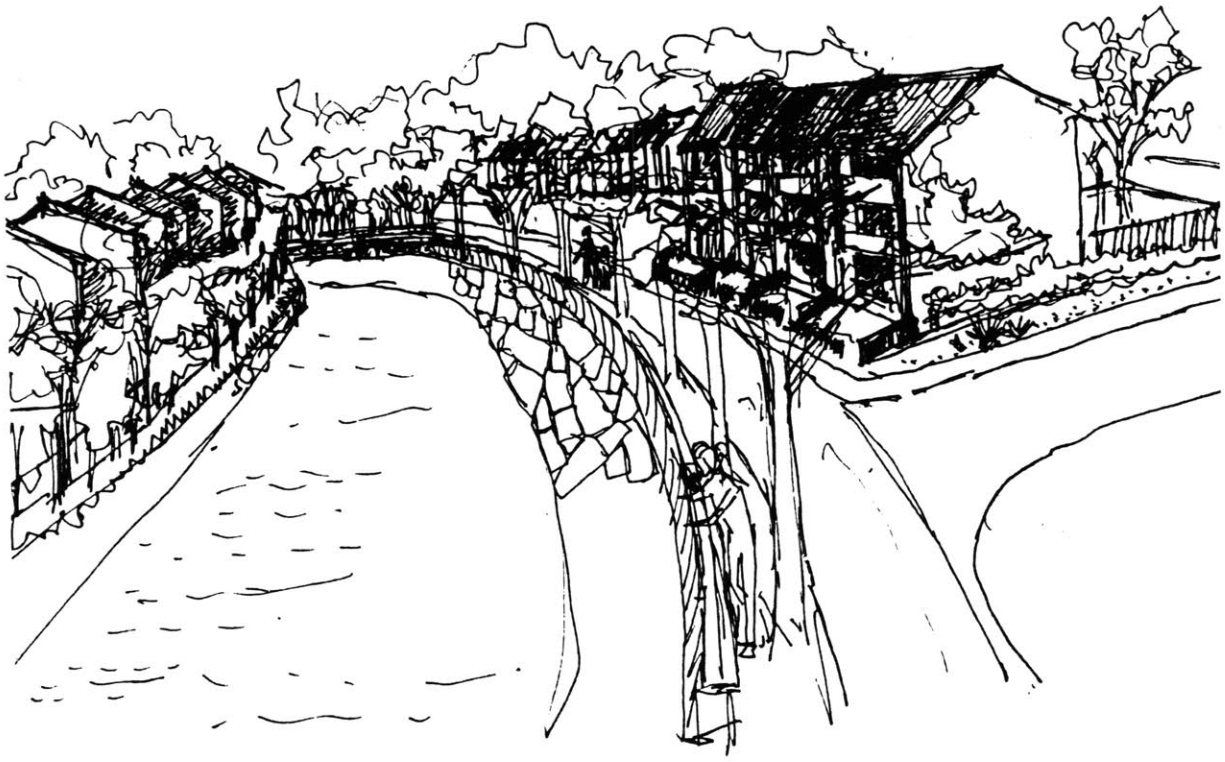
The fifth class:

Residential-only	-- Low-polluting industries
Home-factory residential use	-- Low-polluting industries
Suggested division :	**Natural divisions (River, forest)**

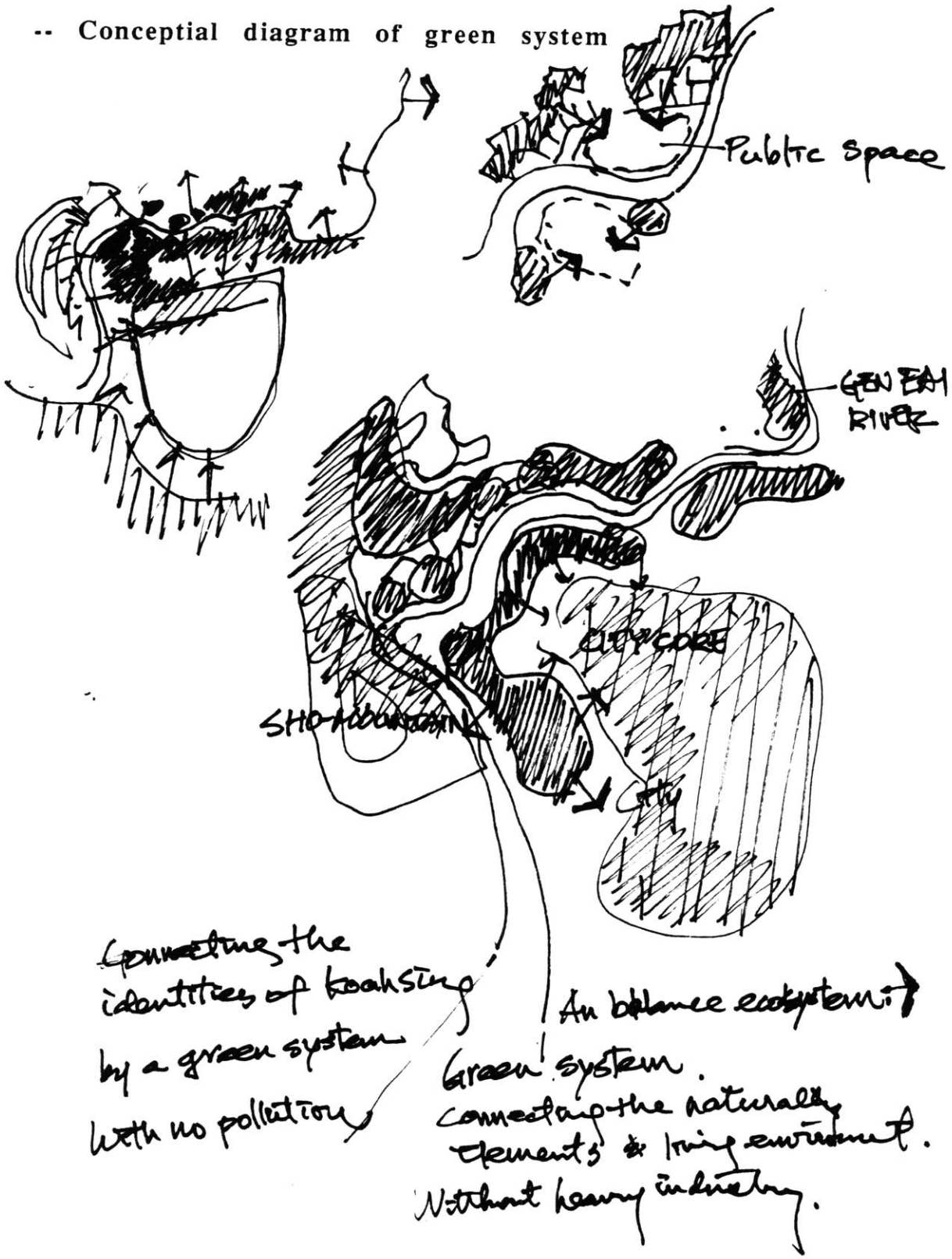
Vision of tomorrow

The balanced ecosystem proposal for the future is to integrate a green system into the urban environment. In the future vision of the site, all the buffer spaces between the industries and the residential spaces, which were mentioned in the previous section, would form a green system to connect the natural elements of Koahsiung--the Sho Mountain and the Gen-Eai River--together, and to bring them back to the human living environment. Some conceptual drawings of this image are proposed at the end of the thesis to project the idea of a balanced ecosystem in Koahsiung.

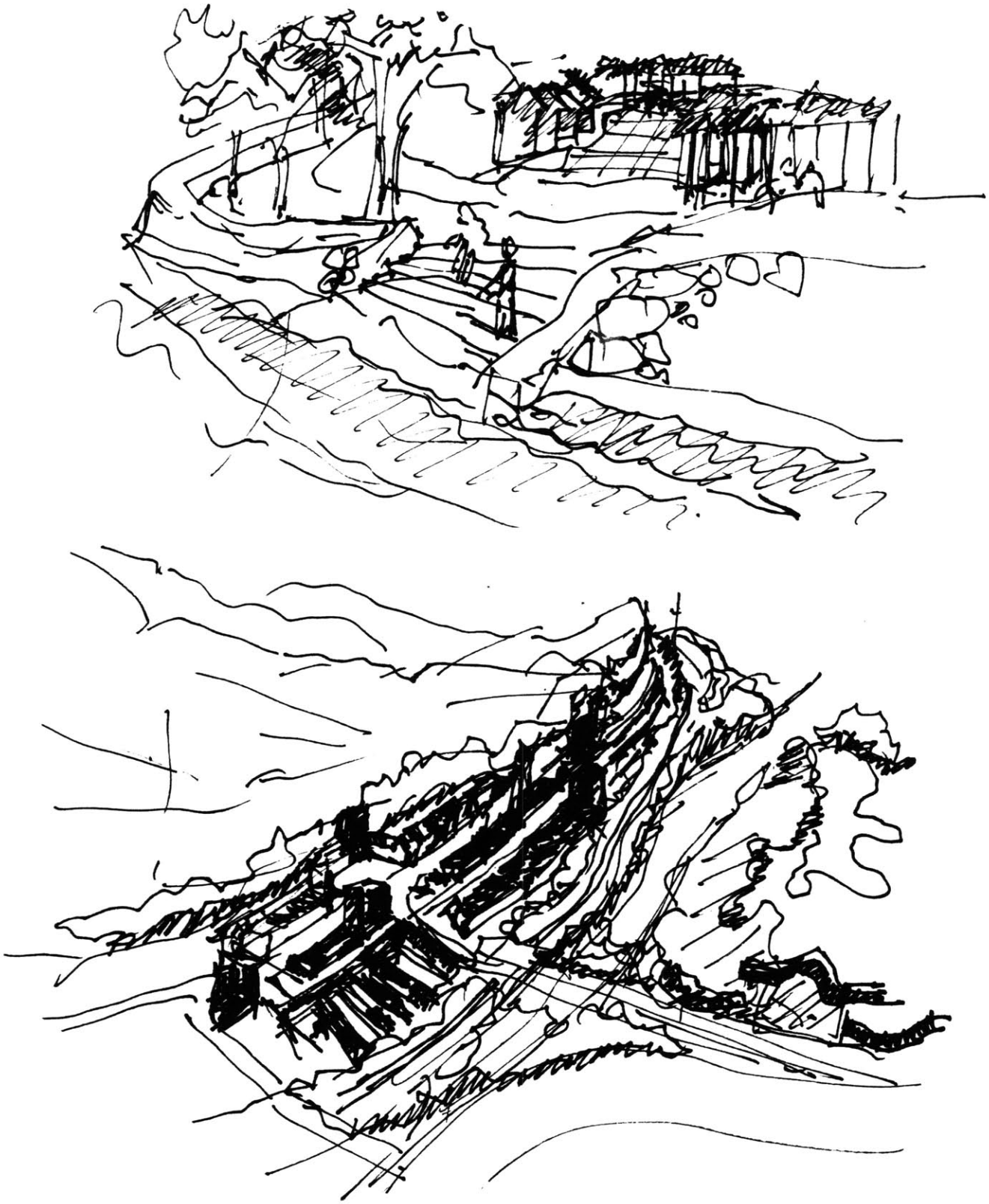
-- Perspective drawing of the riverbank



-- Conceptial diagram of green system



-- People and nature



TABLES

area/ year	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Koahsiung Metro. area	100	100	100	100	100	100	100	100	100	100	100	100
Koahsiung city	71.28	71.54	71.75	72.06	72.16	71.92	71.32	70.91	70.84	70.54	70.15	69.78
Towns in the metro. area	28.72	28.46	28.25	27.94	27.84	28.08	28.68	29.09	29.16	29.46	29.85	30.22

1980	1981	1982	1983	1984	1985		
100	100	100	100	100	100		
69.31	69.14	68.73	68.26	68.33	68.25		
30.69	30.86	31.27	31.74	31.67	31.75		

Table.1 : Metropolitan population distribution and growth. souce: Chang, Chung-Ming" Study of Residential Spatial Structure in Koahsiung Metropolitan Area" Graduate School of Urban Planning in Jung-Shing Univ. Thesis 1987

	1ST CLASS PRODUCTIVITY	2ND CLASS PRODUCTIVITY	3RD CLASS PRODUCTIVITY
1971 POPULATION	37317	94968	165522
%	12.53	31.89	55.58
1973 POPULATION	35741	124145	183822
%	10.4	36.12	53.48
1975 POPULATION	38574	127799	202457
%	10.46	34.65	54.89
1977 POPULATION	42656	136657	214539
%	10.38	34.7	54.47
1979 POPULATION	39555	165777	245187
%	8.78	36.8	54.42
1981 POPULATION	41384	183418	352706
%	6.67	38.41	52.92

Table 2 : Population of the productivities from 1971 to 1981. source: Investigation of Industry and business in Koahsiung 1981

1st class productivity: working on agricultural, forestry, fishing, pestural, mining production

2nd class productivity : working on industry, eletricity, water and gas energy supply, construction

3rd class productivity : working on commercial business, transportation and storage, tele-communication business, service business.

	POPULATION	RESIDENTIAL AREA	PERSONS/ha (DENSITY)	EMPLOYMENT (PERSON)	SUGGESTING DENSITY	
NORTHERN AREA	**312855**	**630.53**	**469**	**79050**	(see footnote)	
GU-SHENG	104315	145.94			600	
ZOU-YING	106559	270.47			720	
NAN-ZUE	101981	214.12			650	
SOUTHERN AREA	**302652**	**480.43**	**629**	**73572**		
SHOW-GONG	101914	184.37			320	
CHENG-GEN	200748	296.06			600	

Table. 3 : Comparison of the residential and employment of northern and southern area of Koahsiung. source: Chang, Jung-Ming Study of Residential spatial structure of Koahsiung Metropolitan Area',1987

CHU	RESIDENTIAL AREA	COMMERCIAL AREA	INDUSTRIAL AREA	OTHERS	TOTAL	NO. OF REGISTERRED FACTORY	FORMAL/ INFORMAL%	NO. OF HOUSING	NO. OF HOUSING/ INFORMAL FACTORY
SANG-MING	797	247	84	42	1168	553	2.11	47659	60
YENG-CHENG	22	40	0	0	62	30	2.07	4856	220
SHING-SHIN	46	57	0	0	103	57	1.81	13062	283
CHEING GING	39	35	0	4	78	29	2.69	7006	180
LING-YARD	291	154	0	13	458	99	4.63	32811	113
CHI-GING	22	2	2	0	26	66	0.39	4029	183
CHENG-GEN	330	22	104	35	491	213	2.31	33570	102
GUE-SHENG	188	23	50	40	301	220	1.37	17129	91
ZOU-YING	148	6	3	21	178	275	0.57	19588	131
NAN-ZUE	125	29	2	11	169	68	2.49	18575	149
SHOW-GONG	96	6	47	7	156	117	1.52	14037	146

Table 4 : No. of illegal factories in Koahsiung. source: "Koahsiung Investigation in illegal factories," 1986, The no. of registered factories in the table is from the data of Dec. 1985) Public Construction Department

	NO. OF FACTORY	%	TOTAL AREA OF FACTORY	%	AVERAGE ARE OF FACTORY	DISTRIBUTION INDICATION	
NON-POLLUTING INDUSTRIES							
transportation tool repair	23	8	6.9549	5.2	0.3	0.0081	
latex production	5	1.7	1.1342	2.47	0.2265	0.0453	
plastic production	17	5.9	2.5639	1.25	0.1513	0.0089	
paper & print	13	4.5	1.3036	0.08	0.1001	0.0077	
leather & fur	1	0.34	0.0851	1.69	0.0851	0.0851	
mechanical repair	37	12.76	1.7513	2.72	0.0013	0.000035	
eletronic	16	5.52	2.8278	3.78	0.176	0.011	
LIGHT POLLUTING INDUSTRIES							
food processing	15	5.17	3.9206	3.78	0.261	0.0174	
cloth & accessory	2	0.69	4.3808	4.22	2.1904	1.0952	
non-metal furniture & timber	31	11.7	41.402	39.9	1.3361	0.0431	
HEAVY-POLLUTING INDUSTRIES							
textile	2	0.69	0.236	0.23	0.118	0.059	
chemical material	1	0.34	0.175	0.17	0.175	0.175	
chemical production	5	1.7	0.4677	0.45	0.0935	0.0187	
non-metal mining	10	3.4	34.4328	25.9	3.4	0.3	
metallurgy	34	11.7	8.2823	7.98	0.2448	0.0072	
metal production	73	25.2	22.6376	22	0.3066	0.0042	
TOTAL	288	100	132.759	100	-	-	

Table. 5 " Industries in the site", source: Evaluation of Industrial development & location in Koahsiung , Public Construction Department of Koahsiung Municipality,1987

AREA/LAND USE	NEN-ZUE		MING-ZU		GU-SHENG NEI WAI		CHENG-GEN		SHOW-GONG		OTHER		TOTAL	
	AREA	%	CORRIDOR	%	AREA	%	AREA	%	AREA	%	AREA	%	AREA	%
INDUSTRIES SPEC.	269.4577	67.9	11.3396	10.5	67.7386	19.8	167.8089	23.9	1183.23	58.1	0.3489	1.9	1699.9237	47.1
I	36.4895	9.1	13.7656	12.7	8.9372	2.6	72.3183	10.4	406.78	20	4.9903	27	534.2809	15.1
II	33.7786	8.5	22.0854	20.4	44.091	12.9	51.1481	7.3	149.655	7.3	2.158	11.7	302.9161	8.4
TOTAL	339.7258	85.5	47.1906	43.6	120.7668	35.3	291.2753	41.6	1739.655	85.4	7.4972	40.6	2546.1207	70.6
RESIDENTIAL	0.0071	-	3.0299	2.8	10.2765	3	37.943	5.4	11.14	0.5	0.6566	3.6	63.0531	1.7
COMMERCIAL	0.1714	-	4.4569	4.1	1.5169	0.5	8.057	1.1	0	0	0.1517	0.8	14.3539	0.4
AGRICULTURE	0	0	18.8559	17.4	97.8726	28.6	72.7786	10.4	0	0	0	0	189.5071	5.3
PUBLIC/ ROAD	23.1002	5.8	2.1475	2	17.637	5.2	53.8852	7.7	39.125	1.9	0	0	135.8899	3.8
PARK	8.1904	2.1	0	0	0	0	4.5866	0.7	0	0	0	0	12.777	0.4
TEMPLE	0	0	1.3988	1.3	0.0989	-	0	0	0	0	0.1025	0.5	1.6002	-
PARKING	0	0	0.0531	0	0.117	-	0	0	0	0	0	0	0.1704	-
WATER	0	0	0.698	0.7	50.9457	14.9	58.4537	83	58.02	2.8	0.9716	5.3	169.089	4.7
HARBOR	0	0	0	0	0	0	0	0	0	0	4.4248	23.9	4.4248	0.1
GOVERNMENT	5.216	1.3	0	0	3.3614	1	0	0	8.82	0.4	0	0	17.3974	0.5
SCOOL	0	0	0	0	0.965	0.3	0	0	0	0	0.1396	0.8	1.1046	-
MARKET	0	0	0.5129	0.5	0	0	0	0	0	0	0	0	0.5129	-
BIG SAIL MARK.	0	0	0.063	0.1	0	0	0	0	0	0	0	0	0.063	-
GAS STATION	0.0659	-	0	0	0.135	-	0	0	1.44	0.1	0	0	1.6409	-
TRASH LOT	0.924	0.3	0	0	0	0	0	0	11.73	0.6	0	0	12.654	0.4
ABATTOIR	0	0	1.5188	1.4	0	0	0	0	0	0	0	0	1.5188	-
CEMETARY	0	0	0.8181	0.8	0	0	0	0	0	0	0.2962	1.6	1.1142	-
STORAGE	2.8859	0.7	4.8036	4.4	1.6524	0.5	86.1699	12.3	14.0725	0.7	3.895	21.1	113.4793	3.1
TRANSPORTATION	0	0	1.315	1.2	0	0	47.4438	6.8	0	0	0	0	48.7588	1.4
TOTAL	40.3827	10.2	13.3287	12.4	74.9124	21.9	250.5392	35.7	133.2025	6.5	9.8297	53.2	522.1952	14.4
VACANT LAND	17.243	4.3	21.308	19.7	36.7227	10.7	40.8656	5.8	153.655	7.6	0.3395	1.8	270.1338	7.5
TOTAL	397.53	100	108.17	100	342.0679	100	701.4587	100	2037.6625	100	18.4747	100	3605.3638	100

table 6 : Land use investigation and analysis of Koahsiung industrial area
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